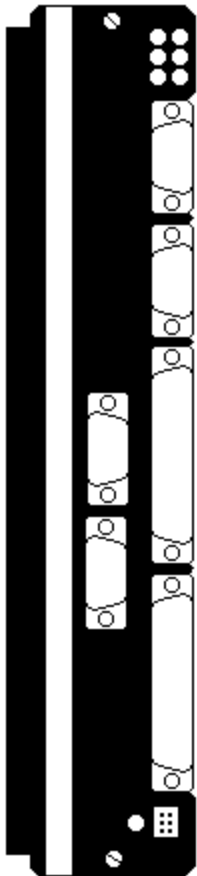


# SMT-BD1/h

gb



## Digital drive with CAN interface

INFRANOR®





**WARNING**

This is a general manual describing a series of servo amplifiers having output capability suitable for driving AC brushless sinusoidal servo motors.

**Instructions for storage, use after storage, commissioning as well as all technical details require the MANDATORY reading of the manual before getting the amplifiers operational.**

**Maintenance procedures should be attempted only by highly skilled technicians having good knowledge of electronics and servo systems with variable speed (EN 60204-1 standard) and using proper test equipment.**

The conformity with the standards and the "CE" approval is only valid if the items are installed according to the recommendations of the amplifier manuals. Connections are the user's responsibility if recommendations and drawings requirements are not met.



Any contact with electrical parts, even after power down, may involve physical damage. Wait for at least 5 minutes after power down before handling the amplifiers (a residual voltage of several hundreds of volts may remain during a few minutes).

**ESD INFORMATION (ElectroStatic Discharge)**

INFRANOR amplifiers are conceived to be best protected against electrostatic discharges. However, some components are particularly sensitive and may be damaged if the amplifiers are not properly stored and handled.

**STORAGE**

- The amplifiers must be stored in their original package.
- When taken out of their package, they must be stored positioned on one of their flat metal surfaces and on a dissipating or electrostatically neutral support.
- Avoid any contact between the amplifier connectors and material with electrostatic potential (plastic film, polyester, carpet...).

**HANDLING**

- If no protection equipment is available (dissipating shoes or bracelets), the amplifiers must be handled via their metal housing.
- Never get in contact with the connectors

**ELIMINATION**

In order to comply with the 2002/96/EC directive of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE), all INFRANOR devices have got a sticker symbolizing a crossed-out wheel dustbin as shown in Appendix IV of the 2002/96/EC Directive.

This symbol indicates that INFRANOR devices must be eliminated by selective disposal and not with standard waste.

INFRANOR does not assume any responsibility for any physical or material damage due to improper handling or wrong descriptions of the ordered items.

Any intervention on the items, which is not specified in the manual, will immediately cancel the warranty.

Infranor reserves the right to change any information contained in this manual without notice.

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Issue: **3.1**



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# ***PART 1***

# ***AMPLIFIER***

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# Chapter 1 - General description

## 1- INTRODUCTION

Series **SMT-BD1** digital servo modules are PWM servo amplifiers that provide speed control for AC sinusoidal motors (brushless) with transmitter resolver.

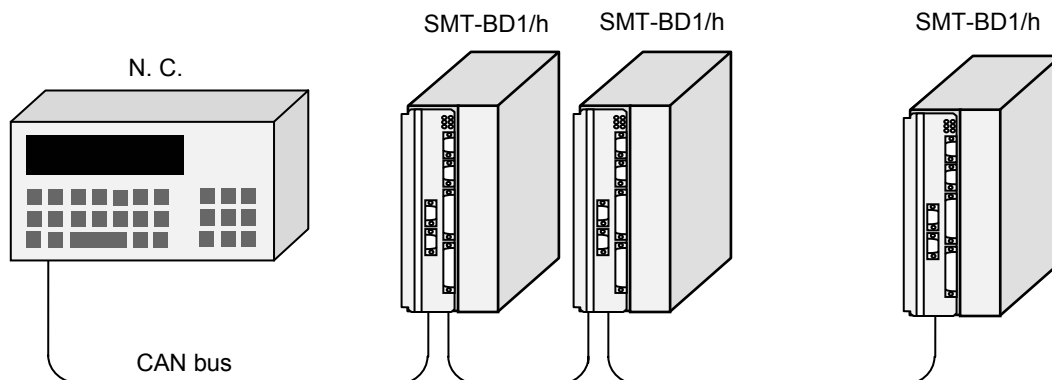
The **SMT-BD1/h** servo drive is 220 VAC or 400 VAC mains operated. The SMT-BD1 plug-in system with 220 VAC power supply is available as a single-axis block version or as a multi-axis version that can receive up to six axes in a standard 19" rack including the power supply. The **SMT-BD1/h** plug-in system with 400 VAC power supply is available as a multi-axis version that can receive up to three axes in a standard 19" rack including the power supply.

NOTE: For the operation with 400 V supply, please see manual [BD1/a-400 V](#).

The amplifier module **SMT-BD1/h** is a version of the standard amplifier SMT-BD1 that is controlled by a CAN interface. This interface allows to receive motion commands by the CAN bus instead of the +/- 10 V analogue input.

This amplifier is entirely controlled by messages exchanges on the CAN bus.

It must be used with position controllers equipped with a CAN interface and controlling the amplifiers according to the protocol described in Part 2 of this manual.



## 2 - CONFORMITY WITH EUROPEAN STANDARDS: « CE » APPROVAL

### 2.1 – GENERAL DESCRIPTION

The **SMT-BD1** amplifiers have their own DC/DC converter to provide appropriate logic voltage to the modules. This power supply can use, as a source, either the bus power voltage of 310 V DC or an auxiliary power supply which is necessary particularly when the position output information needs to be saved.

Each module is packaged as a 6 U "double Eurocard":

- one power board with IGBT transistors,
- one logic board with DSP (Digital Signal Processing).

The **SMT- BD1** amplifier directly controls the motor torque and speed by means of the information provided by a transmitter resolver sensor.

All control parameters are programmable by means of a serial RS 232 link or by means of a CAN bus and saved in a single EEPROM. The auto-phasing and auto-tuning functions allow an easy and quick commissioning of the amplifier.

The basic software **BPCW**, which is IBM-PC compatible with the operating system WINDOWS®, allows the clear display and easy modification of all amplifier parameters. The extended versions of the **BPCW** software include the digital oscilloscope function as well as some other special functions.

## 2.2 - REFERENCE TO THE STANDARDS

The **SMT-BD1** amplifiers operating in the BF rack, which is equipped with the mains filter BF 35, have been approved for their conformity with the Electromagnetic Compatibility standards:

- EN 55011, Group 1, Class A, regarding the conducted and radiated radioelectric disturbances,
- CEI 801 - 2 - 3 - 4 regarding the immunity.

The results and test conditions of the LCIE (Laboratoire Central des Industries Electriques), which is approved by the European Community, are referenced with the n° 416040 - 416041 - 416042 - 416043.

The results of the tests made according to the Low Voltage directive are referenced in the LCIE report n° 413777.

Standard to be applied to the electrical equipments of industrial machines: EN 60204.1

## 2.3 - AFFIXING OF THE « CE » MARK

The "CE" mark has been affixed since 1995.

## Chapter 2 - Specifications

### 1 - TECHNICAL SPECIFICATIONS

Operating voltage	DC bus 310 VDC (270 V < DC bus < 340 VDC)
Auxiliary supply voltage	310 VDC (200 V < U <sub>aux</sub> < 340 VDC)
Motor phase-phase output voltage	200 Vms for DC bus 310 V

Output currents for the **Fusing mode of the I<sup>2</sup>t protection** (see Chapter 8, section 3.3).

AMPLIFIER TYPE	U <sub>rated</sub> (Vrms)	I <sub>max</sub> (Arms) 1 s	Max. authorised rated current (Arms) of the amplifier		
			Without fan*	Fan type 1*	Fan type 2*
SMT-BD1/h-220/04	240	4,4	2		
SMT-BD1/h-220/08	240	8,8	4		
SMT-BD1/h-220/12	240	13,8	6		
SMT-BD1/h-220/17	240	17,7	8,5		
SMT-BD1/h-220/30	240	30,8	10	12	15
SMT-BD1/h-220/30r	240	30,8	10	15	
SMT-BD1/h-220/45	240	48,6	10	15	20
SMT-BD1/h-220/45r	240	48,6	10	20	23
SMT-BD1/h-220/60	240	61	10	19	25
SMT-BD1/h-220/60r	240	61	12	26	30
SMT-BD1/h-220/70	240	70	25	30	35
SMT-BD1/h-220/100	240	100	25	30	35

Output currents for the **Limiting mode of the I<sup>2</sup>t protection** (see Chapter 8, section 3.3).

AMPLIFIER TYPE	U <sub>rated</sub> (Vrms)	I <sub>max</sub> (Arms) 1 s	Max. authorized continuous current (Arms) of the amplifier		
			Without fan*	Fan type 1*	Fan type 2*
SMT-BD1/h-220/04	240	4,4	2		
SMT-BD1/h-220/08	240	8,8	4		
SMT-BD1/h-220/12	240	13,8	6		
SMT-BD1/h-220/17	240	17,7	8,5	8,5	
SMT-BD1/h-220/30	240	30,8	8,5	12	15
SMT-BD1/h-220/30r	240	30,8	10	15	
SMT-BD1/h-220/45	240	48,6	8,5	15	18
SMT-BD1/h-220/45r	240	48,6	10	20	23
SMT-BD1/h-220/60	240	61	8,5	17	20
SMT-BD1/h-220/60r	240	61	12	26	30
SMT-BD1/h-220/70	240	70	17	30	35
SMT-BD1/h-220/100	240	100	25	30	35

\* Maximum ambient temperature = + 40° C, fan 1 = 56 l/s, fan 2 = 90 l/s.

#### NOTE

The **SMT-BD1-X/Xr** amplifier types are equipped with an additional heatsink in order to improve the heat dissipation and increase their rated current. The width of these amplifier types is then 18 TE instead of 12 TE.

PWM cut-off frequency	10 KHz
Maximum inductance between phases	1 mH
Current regulator (PI)	Adjusted to motor
Current loop bandwidth	Cut-off frequency for 45° phase shift: > 1 KHz
Internal current limitation	I <sub>max</sub> : 20 % to 100 % and I <sub>rated</sub> : 20 % to 50 % I <sub>max</sub> duration = 1 second

Speed regulator PI <sup>2</sup>	Sampling period = 0,5 ms
Position regulator	Anti-wind-up system of the integrator Adjustable digital gains
Speed loop and position loop bandwidth	Selectable cut-off frequency for 45° phase shift: 50 Hz, 75 Hz or 100 Hz Filtre antirésonance
Max motor speed	Adjustable from 100 rpm to 14 000 rpm
Encoder position output	Two A and B channels in quadrature with n marker pulse(s) per revolution Programmable resolution: max. 8 192 ppr up to 900 rpm max. 4 096 ppr up to 3 600 rpm max. 1 024 ppr up to 14 000 rpm Accuracy: 8 arc minutes + _point (2 arc minutes +_point on request) Note: the total accuracy must take into account the resolver accuracy.
Analogue outputs (test connector)	Speed input command (CV): ±10V for ±max. speed. Speed monitor (GT): ±8 V for ±14000 rpm, linearity: 10 % Current input command (IDC): ±10 V for amplifier current rating, resolution 8 bits Current monitor (Imon.): ±10 V for amplifier current rating, resolution 8 bits
Logic inputs	Enable / Disable: ENABLE Limit switch +: FC+ Limit switch -: FC- Index input: INDEX Entrée pour capture position : CI Fault reset: RESET
Logic outputs	Relay contact U <sub>max</sub> = 60 V I <sub>max</sub> = 200 mA, P <sub>max</sub> = 10 W « Amp. ready »: closed if amplifier OK, open if fault « Power ready »: closed if power OK, open if fault Brake control
Command inputs	CAN bus Speed: 1 Mbit Standards: ISO/DIS 11898
Fault display	LED on front panel and diagnostic by serial link
Motor and application parameter setting	Serial link RS232 and CAN bus
Automatic functions	Amplifier adjustment of the motor (AUTO-PHASING) Regulator tuning (AUTO-TUNING) Index research (HOME) Position capture (CI)
Conformity with the standards: "CE" approval with multi-axis power supply configuration BF rack and mains filter BF 35 or 70, or SMTB.M 20 A single-axis rack and BF 35 filter. « 360° » shields; equipotentiality according to the wiring rules.	Standards regarding the Electromagnetic: Compatibility: Immunity: CEI 801 - 2 - 3 - 4 Conducted and radiated disturbances: EN 55011, Group 1, class A Electrical standards for industrial machines: - EN 60204-1 : - Insulator: 1500 Vac / 1 min - Leakage current > 3 mA (EMI filters)

Temperature	From 40° C on, the rated currents must be reduced of 3%/°C Max. temperature: 50° C
- storage -20° C to +70° C - operation +5° C à +40° C	
Altitude	1000 m
Moisture	< 50% at 40° C and < 90% at 20° C: EN 60204-1 standard
Cooling	Natural convection or forced air, according to the rated current (see current table in chapter 2, section 1)

## 2 - MAIN PROTECTIONS

### 2.1 - DISPLAYED PROTECTIONS

PROTECTION	ERROR DISPLAY	LED*
Amplifier rated current overload* : - flashing display = Idyn signal (I <sup>2</sup> t threshold is reached) - continuous display = amplifier inhibited (I <sup>2</sup> t fault)	I <sup>2</sup> t	⊗ ● ● ●
Position following error	Position	● ● ● ⊗
CAN input command fault	CAN reference	⊗ ● ● ⊗
Resolver cable interruption	Resolver	● ⊗ ● ●
Power stage failure: - power supply overvoltage - internal switch protection - short-circuit between phases - amplifier overtemperature for 4 A to 60 A current ratings	Power stage	⊗ ⊗ ● ●
Resolver converter failure	R.D.C.	● ● ⊗ ●
Amplifier overtemperature for 70 A and 100 A current ratings	°C Amp.	⊗ ● ⊗ ●
Power supply undervoltage	Undervolt.	● ⊗ ⊗ ●
Motor overtemperature	°C Motor	⊗ ⊗ ⊗ ●
Fault of the amplifier parameter storage	EEPROM	⊗ ● ⊗ ⊗
Amplifier automatic procedure: - flashing display = procedure operating - continuous display = operating error	BUSY	⊗ ⊗ ⊗ ⊗

● : Led is unlit      ⊗ : Led is lit.

\* Please see I<sup>2</sup>t protection mode in [Chapter 8, section 3.3](#).

All these faults are memory stored in the amplifier except for the fault "Undervolt."

The reset of a stored fault can be made:

- via the CAN bus ([command 93](#)),
- via the fault RESET input (pin 13 of the X4 connector),
- by switching off the amplifier power supply.

### 2.2 - PROTECTION BY FUSES

F1 : Control of the average DC current of the power board supply ([see chapter 8](#)).

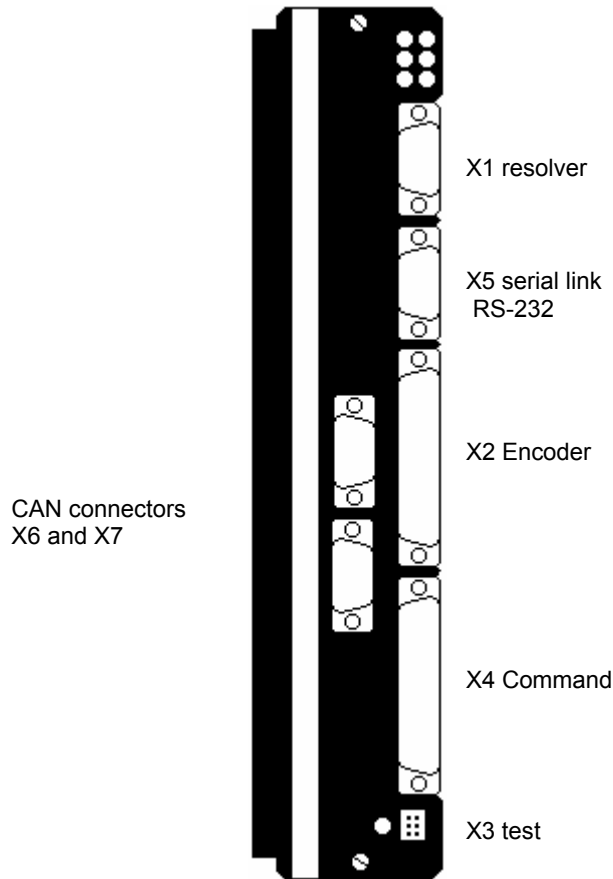
F2 : Control of the average DC current of the logic board supply ([see chapter 8](#)).

AMPLIFIER TYPE	F1 POWER	F2 LOGIC
SMT-BD1/h-220/04 to 12	10 AT	1 A
SMT-BD1/h-220/17 and 30	15 AT	1 A
SMT-BD1/h-220/45	20 AT	1 A
SMT-BD1/h-220/60	20 AT	1 A
SMT-BD1/h-220/70	-	1 A
SMT-BD1/h-220/100	-	1 A

# Chapter 3 - Inputs-Outputs

## 1 - CONNECTORS LOCATION

Front connectors



## 2 - X1 RESOLVER CONNECTOR

Sub D 9 points female.

PIN	FUNCTION	REMARKS
1	TC (pin H sensor connector)	If thermal switch connected to X1
6	Shield connection	If no "360°" connection on the connector
2	TC (pin I sensor connector)	If thermal switch connected to X1
7	S1 (pin C sensor connector)	MAVILOR motor with TAMAGAWA resolver
3	S3 (pin D sensor connector)	MAVILOR motor with TAMAGAWA resolver
8	S4 (pin B sensor connector)	MAVILOR motor with TAMAGAWA resolver
4	S2 (pin A sensor connector)	MAVILOR motor with TAMAGAWA resolver
9	R2 (pin F sensor connector)	MAVILOR motor with TAMAGAWA resolver
5	R1 (pin E sensor connector)	MAVILOR motor with TAMAGAWA resolver

For resolver connections other than the TAMAGAWA resolver on MAVILOR motors, please see resolver wiring table in [Chapter 8 \(Appendix\), section 2.](#)

### 3 - X2 ENCODER CONNECTOR

Sub D 25 points female

PIN	FONCTION	I/O	REMARQUE
1	/CZ	S	Differential output of the encoder marker pulse (5 V, 20 mA max.)
2	CZ	S	Differential output of the encoder marker pulse
3	/CA	S	Differential output of the encoder channel A (5 V, 20 mA max.)
4	CA	S	Differential output of the encoder channel A
5	/CB	S	Differential output of the encoder channel B (5 V, 20 mA max.)
6	CB	S	Differential output of the encoder channel B
7, 10, 11	0 V		
12	/A	E	Differential input of the encoder channel /A
13	A	E	Differential input of the encoder channel A
14	/B ou LIN0	E	Differential input of the encoder channel /B or logic input LIN0 (optocoupled)
15	B ou LIN1	E	Differential input of the encoder channel B or logic input LIN1 (optocoupled)
16	/Z ou LIN2	E	Differential input of the encoder channel /Z or input LIN2 (optocoupled)
17	Z ou LIN3	E	Differential input of the encoder channel Z or input LIN3 (optocoupled)
24	5 V		+/- 5 %, 300 mA available with jumper 5 V closed for encoder supply
8	LIN4	E	Logic input LIN4 (optocoupled)
18	LIN5	E	Logic input LIN5 (optocoupled)
9	LOUT0	S	Logic output LOUT0 (optocoupled)
20	LOUT1	S	Logic output LOUT1 (optocoupled)
21	LOUT2	S	Logic output LOUT2 (optocoupled)
22	LOUT3	S	Logic output LOUT3 (optocoupled)
23	GND 24 V		0 V for optocoupled I/O
25	GND		

The encoder output is optional.

When the encoder output is available, the logic inputs LIN0, LIN1, LIN2 and LIN3 are not available.

### 4 - X3 TEST CONNECTOR

PIN	FUNCTION	REMARKS
1 - 6	0 Volt	
2	Current input command I DC	$\pm 10$ V; resolution: 8 bits, linearity: 2 % (DAC out 1)*
3	Speed input command CV	$\pm 10$ V for $\pm$ max. speed
4	Speed monitor GT	$\pm 8$ V for $\pm 14000$ rpm
5	Current monitor I mes	$\pm 10$ V; resolution: 8 bits, linearity: 2 % (DAC out 2)*

\*: 10 V for amplifier current rating

Linearity 10% for 01612A, 01612B or 01612C logic board.

## 5 - X4 INPUT-OUTPUT COMMAND CONNECTOR

Sub D 25 points male.

PIN	FUNCTION	I/O	REMARKS
1	Limit switch +	I	Positive limit switch
14	Limit switch -	I	Negative limit switch
24	0 Volt of limit switch	I	
20	ENABLE	I	ENABLE "hardware" condition
23	0 Volt ENABLE	I	
4	Current control CI	I	Positive capture input
7	Index input	I	Index research input
25	0 Volt logic input		
13	RESET	I	Amplifier reset via 0 V (contact between pins 13 and 12)
12	0 Volt RESET	I	
15	reserved		
16	reserved		
17	reserved		
3	reserved		
10	Speed monitor output	O	
2	Current measurement output	O	
11	0 Volt analogue output	O	
18, 19	Amplifier ready	O	Relay contact: closed if amplifier OK Pmax = 10 W with Umax = 50 V or Imax = 100 mA
8, 9	Brake control output	O	Relay contact Pmax = 10 W with Umax = 50 V or Imax = 100 mA
21	+15 V	O	Max. 50 mA
22	-15 V	O	Max. 50 mA
5, 6	non connected		

The inputs ENABLE, INDEX, CI and Limit switch can be configured either in positive or in negative logic.

## 6 - X5 CONNECTOR RS-232

PIN	FUNCTION	REMARKS
5	0 V	GND (connection of the shield if no "360°" connection on the connector)
3	TXD	Transmit data RS 232
2	RXD	Receive data RS 232
6	TXH	Transmit data RS 422/485
7	TXL	Transmit data RS 422/485
8	RXL	Receive data RS 422/485
9	RXH	Receive data RS 422/485

## 7 - CAN CONNECTORS

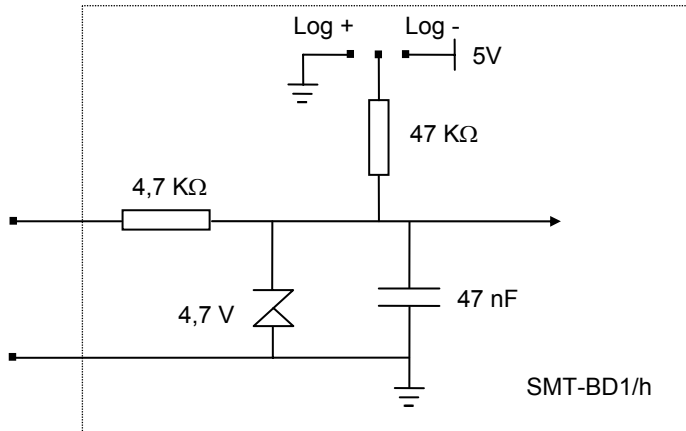
- Link without insulation.
- In conformity with standard ISO/DIS 11898.
- In conformity with the recommendation DS-102, version 2.0 of the CAN in Automation Association.
- 1 connector sub D 9 points male and 1 connector sub D 9 points female on each amplifier.

PIN	FUNCTION	REMARKS
2	CAN_L	Line CAN_L (dominant low)
3	CAN_GND	CAN earth (ground)
7	CAN_H	Line CAN_H (dominant high)



### 8 - SPECIFICATIONS OF THE LOGIC INPUTS-OUTPUTS

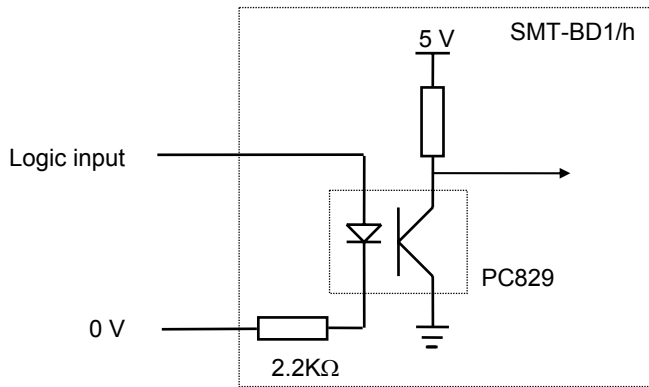
Assigned logic inputs: FC+, FC-, INDEX and ENABLE.



Input impedance: 4,7 KΩ

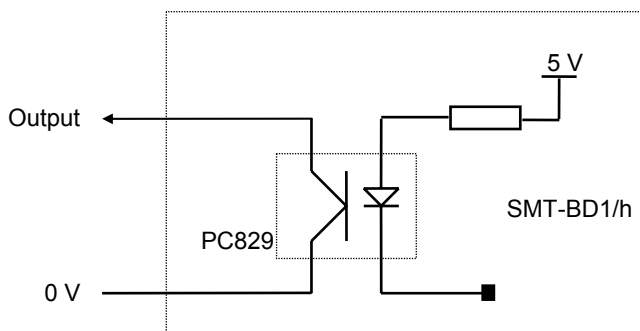
Response time:  
FC+, FC-, INDEX, ENABLE : 500 μs.  
CI : 50 μs.

Logic inputs LIN0 to LIN5:



The input voltage corresponding to level 1 is between 5 V and 24 V

Logic outputs LOUT0 to LOUT3:



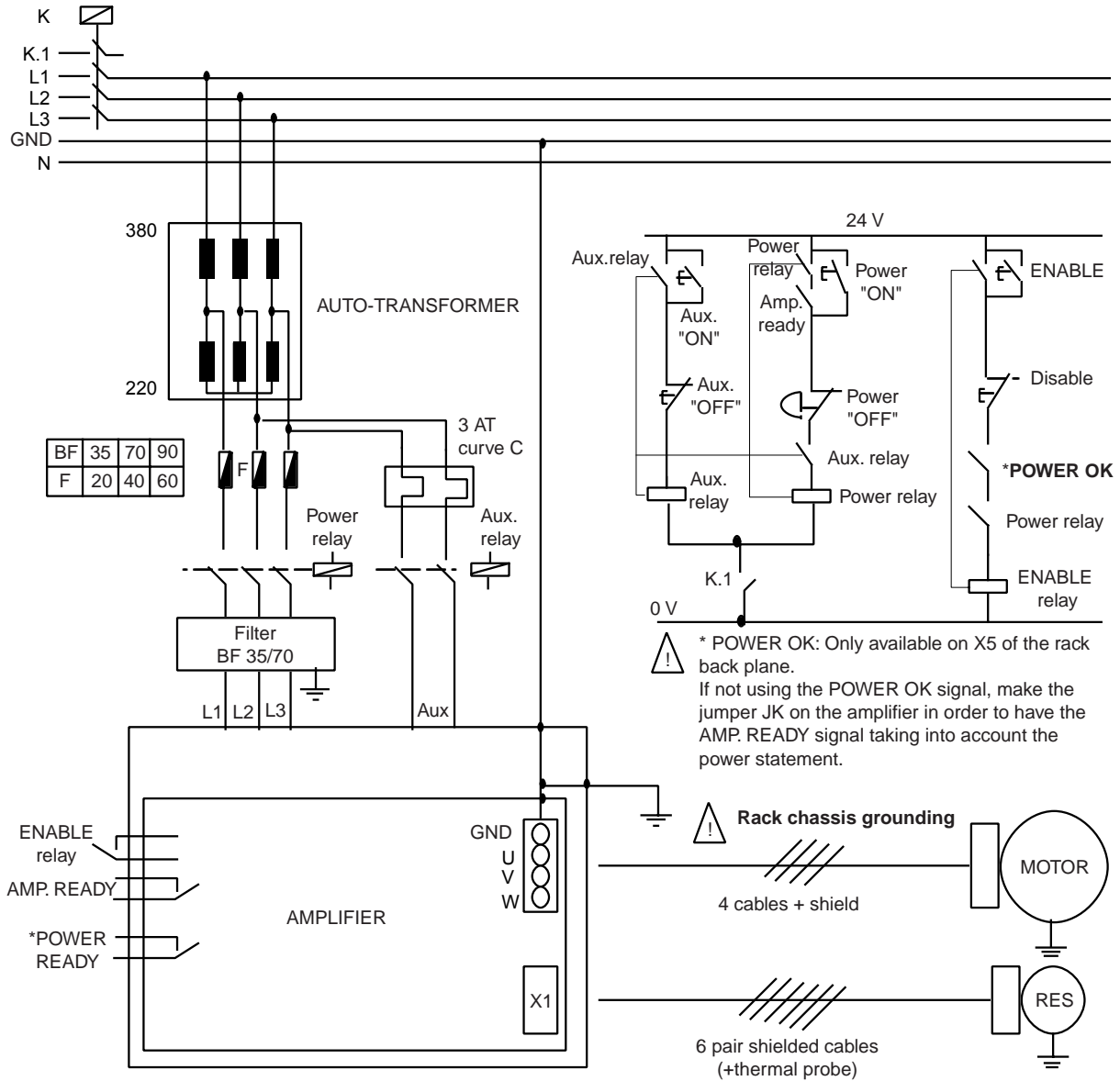
The logic outputs are open collector outputs.

The output current is 5 mA.

# Chapter 4 - Connections

## 1 - CONNECTION DIAGRAMS

### 1.1 - POWER CONNECTION WITH THE SMT-BM 20 A SINGLE-AXIS OR THE BF RACK

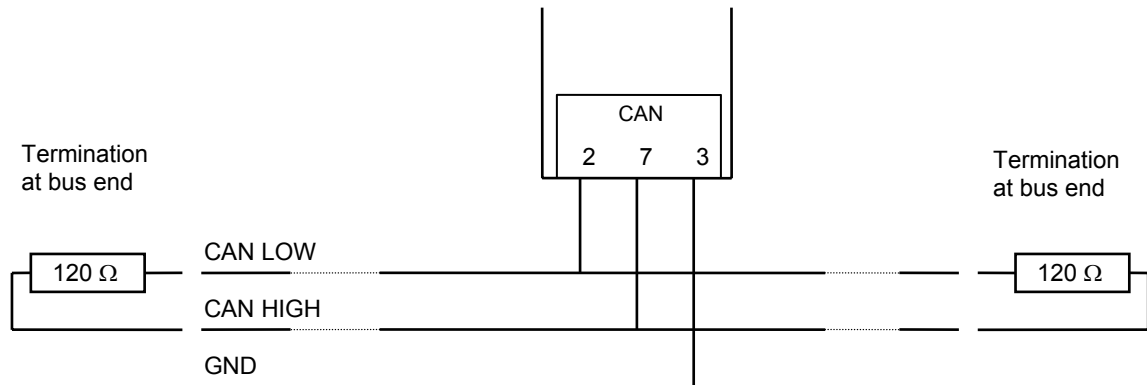


(\*): Only for BF rack

For more details about the power connection, see manuals [SMTB.M 20 A SINGLE-AXIS RACK](#) or [BF RACK](#).

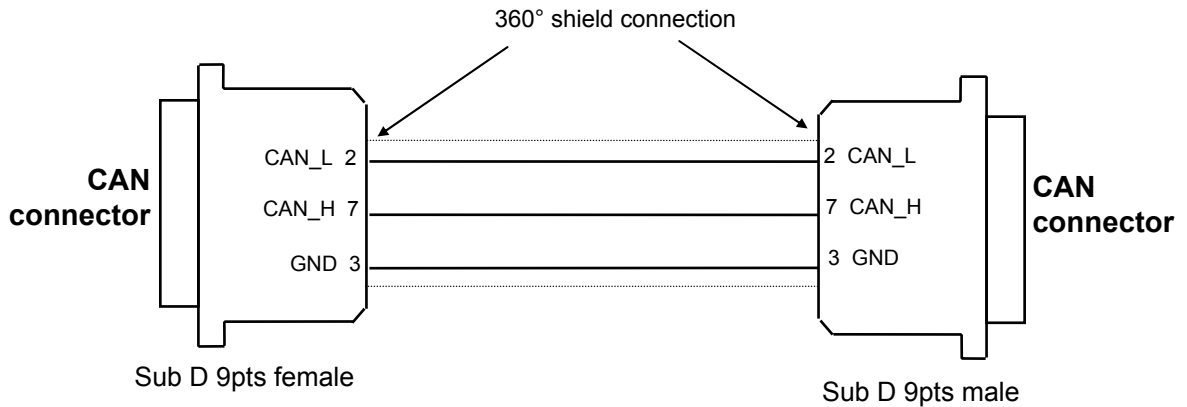
### 1.2 - CAN INTERFACE CONNECTION

For each amplifier connected to the network:

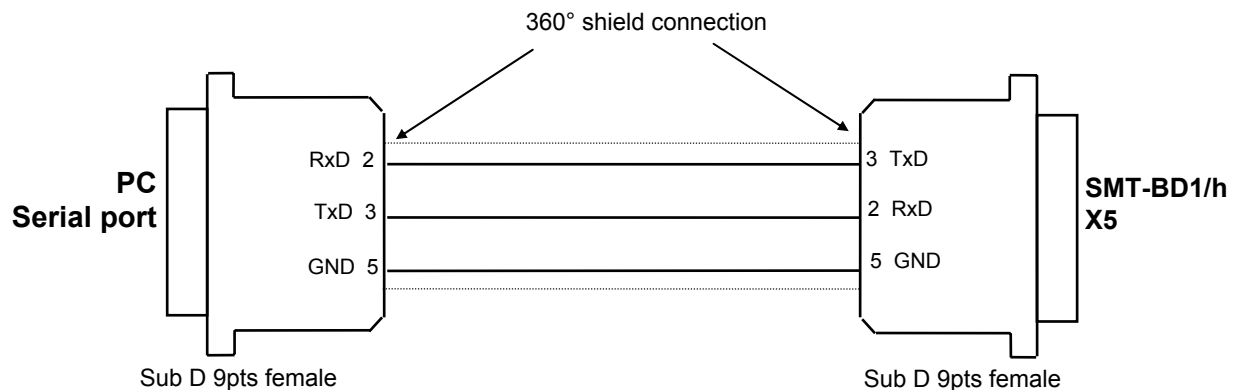


The cable specification is about 120 Ω.  
 The whole cable length must not exceed 40 m at 1 Mbit.  
 Both cable ends must be connected to a 120 Ω load resistor.

Cable required for the connection between 2 nodes:



### 1.3 - RS 232 SERIAL LINK CONNECTION



## 2 - WIRING

(according to CEI 801 and EN 55011 standards) - [See drawings of chapter 8, section 5](#)

## 2.1 - GND WIRING AND GROUNDING

The reference potential is the **earth (ground)**. Motors and resolvers are grounded via their housing. If a potential reference is available, like a main chassis or a cabinet, with a low impedance between its various elements, it should be used for short connections and also be grounded itself.

Long reference potential connections (especially groundings) are suitable **ONLY** if these connections have a very low impedance ( $< 0,1 \Omega$ ).

Cables with low potential should **NEVER** run in the proximity of power lines.

**Each conductor cable** (carrying a potential) must be **shielded**. Several wires in the **same sleeve** must be **twisted** and **shielded**.

According to the **CEI 801 standard**, the connectors must be metallic or metal plated and must have a **360° shield connection** (see Chapter 8, section 6).

## 2.2 - MOTOR AND RESOLVER CABLES

Cable ends should have a metallic collar allowing a 360° shielded connection.

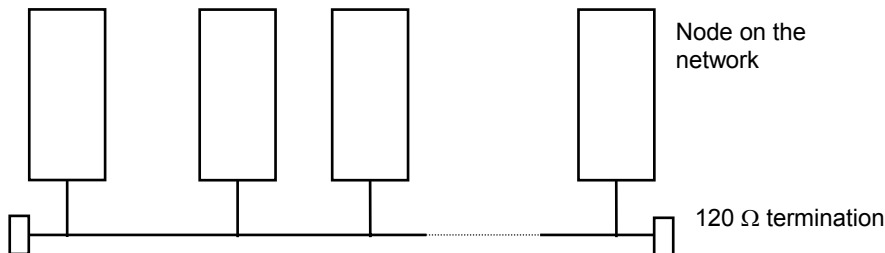
The recommended resolver cable is a **three pair twisted with an individual shield on each pair** (sin, cos, ref.).

Motor cables must also be shielded.

## 2.3 - CAN AND SERIAL LINK CABLES

The CAN bus signal cable must be a pair twisted and shielded one. The cable specification must be about  $120 \Omega$  and both bus ends must be connected to a  $120 \Omega$  load resistor.

The shield connection must be made over "360°" via metallic connectors at both cable ends.



The serial link cable must also be shielded according to the above mentioned shielding recommendations.

### CAUTION !

The command cables (CAN, serial link, resolver) as well as the power cables **MUST** be **connected** and **disconnected** with the amplifier **TURNED OFF**.

## Chapter 5 - Adjustable functions

### 1 - PARAMETER SETTING

The SMT-BD1/h amplifier only operates with CAN interface.

All parameters can be modified via a function defined in a CAN message. A parameter or an amplifier procedure can be activated by means of a command which number is given in Part 2 of this manual (CAN Communication Protocol).

It is also possible to modify the parameters via the serial link. The BPCW software allows to adjust the amplifier parameters from a PC. The use of BPCW is described in the [SMT-BD1 standard manual](#).

The BPCW software also allows to modify the CAN bus communication speed which standard value is 1 Mbit. The new communication speed is effective when the amplifier is switched on again (the modifications must then be saved in the amplifier EEPROM).

### 2 - ADRESSING

- \* Each amplifier of the CAN network must have one single address different from 0. There are 4 micro-switches on the amplifier (SW1) that allow to define an address between 1 and 15 (see [Chapter 8, section 1: Hardware adjustment, for the location of these switches](#)).
- \* The amplifier addresses must be defined per group:
  - group 0: addresses 1 to 7 (max. 7 axes)
  - or group 1: 8 to 15 (max. 8 axes).

# Chapter 6 - Commissioning

## 1 - CHECKING THE AMPLIFIER CONFIGURATION

The standard amplifier configuration for MAVILOR motors with a TAMAGAWA resolver is the following:

- Personalization board **P RES** resolver: 4 x 12,7 kΩ 1 %.
- Adjustment of the current loops according to the table of chapter 8, section 1.
- Motor thermal switch PTC : jumper **MN**.
- Positive logic: jumpers **E. F. G** closed.
- No auxiliary supply: jumper **JK** closed and jumper **KL** open.

See Chapter 8, sections 2, 3 and 4 for the amplifier adjustment to other motor or resolver types or to another control logic.

## 2 - PUTTING INTO OPERATION

Check the secondary voltage of the power transformer: **rated** value 220 Vrms between phases, maximum value without load < 260 Vrms (including all variations, especially mains fluctuations).

Check the continuous DC bus voltage on the back of the rack: UDC ~ 310 V, UDC max < 370 V, UDC min > 200 V.

The braking resistor must remain cool (CAUTION ! This resistor is under high voltage).

Turn off the power supply and wait until the voltage drops below 10 V before plugging in the first amplifier.

"ENABLE" input activated.

Plug in the amplifier and apply power.

### 1st CASE

Use without auxiliary power supply.

When applying power, the green LED "**ON**" must lit and the red "ERROR" LEDs must be off after the **AUTOTEST** procedure of the amplifier.

### 2nd CASE

Use with auxiliary power supply (see chapter 8, section 4.2).

When applying power, the "**Undervolt.**" fault may be displayed.

Turn on the power supply: the fault is cancelled.

### CAUTION

In case of power cut-off, WAIT AT LEAST 5 SECONDS before switching on again the amplifier.

## 3 - AMPLIFIER COMMISSIONING AND ADJUSTMENT

The amplifier operation is depending on the CAN messages, even during the adjustments. Particularly the synchro message and the input command message must be continuously available (see Part 2 of this manual: [CAN communication protocol](#)).

### 3.1 - AMPLIFIER ADJUSTMENT TO A NEW MOTOR

Select the amplifier and fan types used according to the [current ratings table of chapter 2, section 1](#).

Select the amplifier current limitation mode (**command 78, I<sup>2</sup>t mode**). The **Fusing** mode should be used during the commissioning phases.

Check that the values of the parameters **Maximum current (command 76)** and **Rated current (command 77)** are compatible with motor and amplifier. Otherwise, modify them according to the motor and amplifier specifications.

Check that the value of the parameter **Maximum application speed (command 61)** is compatible with motor and application. Otherwise, modify it according to the motor and application specifications.

Uncouple the motor from the mechanical load and check that the motor shaft is free and that its rotation over one revolution is not dangerous for the operator.

Execute the **Auto-phasing** function (the ENABLE signal must be activated) in order to define the parameters **Pole pairs**, **Motor phase** and **Resolver adjustment**. Please note that during the **Auto-phasing** procedure, the motor is automatically enabled and then disabled at the end of the procedure.

Define the **Phase lead** parameter (**command 71**) according to the specific motor parameters (the effects of this parameter are particularly interesting on motors with low inductance and running at high speeds):

Phase shift:

$$\tan\varphi = \frac{0,6 \cdot 10^{-7} \cdot K_t \cdot N_p \cdot (\text{MaxMotorSpeed})^2}{L \cdot I_{\text{rated}}}$$

Kt: Motor torque constant (Nm/A<sub>rms</sub>)

Np: Number of motor pole pairs

MaxMotorSpeed: Maximum motor speed (rpm)

I<sub>rated</sub>: Motor current (A<sub>rms</sub>)

with:  $0 \leq \varphi \leq 45^\circ$

Phase lead coefficient (electrical degree/1000 rpm):

$$\text{Coef} = \varphi \frac{1000}{\text{MaxMotorSpeed}}$$

### 3.2 - ENABLING

- The SMT-BD1/h amplifier can be enabled only by means of the CAN bus (**command 91**).
- In standard, the amplifier is disabled when turned on.
- If there is a fault, the amplifier is disabled and remains disabled even after the fault has been reset.
- The ENABLE signal is necessary for the enabling. When this signal is disabled the amplifier is disabled too.

### 3.3 - AMPLIFIER ADJUSTMENT

Select the speed regulator type used (P, PI or PI<sup>2</sup>) or the position regulator (**command 40**). In the case of an axis with unbalanced load (i.e. constant torque due to a vertical load), please see section 3.6 of this chapter.

Check that the motor shaft is free and that its rotation over one revolution is not dangerous for the operator and the machine before executing the auto-tuning procedure.

After the execution of the auto-tuning procedure, check that the motor is correctly running in both directions. Check for the **response at low speed without IDC saturation**.

Adjust more accurately the loop response stability by adjusting, if necessary, the value of the gains calculated by means of the auto-tuning procedure.

### 3.4 - PARAMETER SAVING

When all adjustments are made, it is necessary to save the parameters in the EEPROM by executing the **command 94** with the amplifier disabled.

### 3.5 - BRAKE CONTROL

- The SMT-BD1/h amplifier is equipped with a brake control signal.
- This brake control signal is low powered and cannot directly control the brake. The BMM05F rack module is therefore equipped with a power relay allowing the brake control.
- The brake control is enabled (relay open) or disabled (relay closed) according to the amplifier statement (enabled or disabled).

### 3.6 - SPEED LOOP ADJUSTMENT WITH VERTICAL LOAD

In the case of an axis with unbalanced load (i.e. constant torque due to a vertical load), proceed as follows:

Select the current limitation mode **Limiting**.

Select the speed regulator type **PI** or **PI<sup>2</sup>**.

Initialize the speed loop gains corresponding to the unloaded motor (execute the auto-tuning function with the motor uncoupled from the mechanical load).

Couple the motor to the load. If possible, execute a control in speed loop by means of the NC; otherwise, close the position loop with a stable gain.

Move the shaft by means of the NC until a maintaining position where one motor revolution is not dangerous for operator and machine (far enough from the mechanical stops).

Start the **Auto-tuning** function with the motor at standstill. If the shaft is moving, then the **Auto-tuning** procedure has not been executed by the amplifier.

If necessary, adjust more accurately the speed loop response stability by modifying the gain values.



## Chapter 7 - Fault finding

### 1 - SYSTEM FAULT

If the red **SYS** led is lit when the amplifier is on, the logic board is defective.

- Check that the EPROM is correctly plugged on the amplifier.
- Check for the correct EPROM version that must be x.x2.
- Check for the possible presence of any conducting dust that may involve short-circuits on the amplifier logic board.

### 2 - STORED FAULTS

If a fault occurs on the amplifier, it can generate the detection of several other faults which are only a consequence of the initial one. In order to make diagnostic and maintenance easier, the faults are displayed and processed with decreasing priority as described below. For safety reasons, the power must be turned off when handling the amplifier; in this case, the faults are automatically reset when power is turned on again. If power is not turned off, do not forget to make a RESET immediately after the fault has been cancelled.

#### 2.1 - "BUSY" FAULT

- If the BUSY fault is continuously displayed after power on, the **AUTO-TEST** procedure has failed and the board is not ready for operation.
- If the BUSY fault is continuously displayed after the execution of the **AUTO-PHASING** function, the procedure has failed because of an external cause and the calculated parameters are wrong. Check that the **ENABLE** input is activated. Then check that the motor is unloaded and the shaft free during the procedure.
- If the BUSY fault is continuously displayed after the execution of the **AUTO-TUNING** function, the procedure has failed because of an external cause and the calculated parameters are wrong. Check that the **ENABLE** input is activated. Then check that the motor shaft is free during the procedure.

#### 2.2 - "EEPROM" FAULT

- Check the presence of the EEPROM and check its correct orientation.
- If the fault remains, the EEPROM is not correctly initialized (**CHECKSUM**) or is not compatible with the amplifier software version.

#### 2.3 - "MOTOR OVERTEMPERATURE"

- If the fault occurs when starting the amplifier:
  - \* Check the configuration of the **MN** and **OP** jumpers with regard to the type of thermal switch used in the motor.
  - \* Check the connection between the thermal switch and the amplifier on the front panel connector X1 or the X6 rear connector of the rack, according to the wiring used.
- If the fault occurs during the operation:
  - \* Check the motor temperature and look for the reason of this overheating (mechanical shaft overload, duty cycle too high, ...).

## 2.4 - "UNDERVOLT" FAULT

- If the fault occurs when starting the amplifier:
  - \* Check that the power supply is on.

## 2.5 - "°C AMPLI" FAULT

Check that the fan is correct with regard of the rated current required (see current ratings table in [Chapter 2, section 1](#)).

## 2.6 - "POWER STAGE" FAULT

- If the fault occurs when starting the amplifier:
  - \* Check the DC bus voltage and the terminal voltage of the power transformer secondary (DC bus < 370 VDC and V secondary < 260 VAC).
- If the fault occurs during the operation:
  - \* Check the braking system operation during the motor deceleration phases,
  - \* Check the sizing of the braking resistor with regard to the deceleration phases.
  - \* Check the amplifier current cycle with regard to the current table ([chapter 2, section 1](#)).
  - \* Check for any short-circuit in the motor wiring and at the motor terminals.

## 2.7 - "RESOLVER" FAULT

- Check the resolver connection on the amplifier connector X1.
- Check for the P-RES components on the amplifier.
- Check that the resolver type is correct with regard to the P-RES components ([see chapter 8, section 2](#)).
- Check the connections between resolver and amplifier and at the resolver terminals.

## 2.8 - "R.D.C" FAULT

- If the fault occurs when starting the amplifier:
  - \* Check the values of the P-RES components with regard to the resolver transformation ratio.
- If the fault occurs during the operation:
  - Check that the motor speed does not exceed the speed limit defined below.
  - If **Maximum speed**  $\leq$  900 rpm, then speed limit = 900 rpm.
  - If 900 rpm < **Maximum speed**  $\leq$  3600 rpm, then speed limit = 3600 rpm.
  - If 3600 rpm < **Maximum speed**  $\leq$  14000 rpm, then speed limit = 14000 rpm.
  - Be careful about the torque mode operation where the motor speed is given by the load.

## 2.9 - "I<sup>2</sup>T" FAULT

- Check the rated current value required with regard to the table of currents authorized in pulse mode cycle ([chapter 2, section 1](#)).
- Check the rated current of the amplifier defined in the **Rated current** parameter with regard to the current required for the operation cycle.

## 2.10 - « CAN REFERENCE» FAULT

- Check the communication speed between NC and amplifiers.
- Check that both synchro message and input command message are available and check the amplifier CAN messages configuration.
- Check for the correct amplifiers addresses.
- Check for any problem on the bus (no 120  $\Omega$  termination, cable too long, too many messages with regard to the cycle time, ...).
- If the problem is not due to one of the above described faults, increasing the CAN error threshold (**command 43**) of 500 or 1000 may solve the problem.

## 3 - OPERATING PROBLEMS

### 3.1 - MOTOR DOES NOT MOVE

- Check that the amplifier is on.
- Check that the power supply is on.
- Check the amplifier fuses (F1 and F2) and the motor connection.
- Check the logic wiring of the signals FC+, FC- and ENABLE ([chapter 8, section 4](#)).
- Check that the amplifier is actually enabled:
  - In standard, the amplifier is disabled at power on.
  - The amplifier can only be enabled by means of a CAN message (**command 91**).
  - When the amplifier is disabled by a fault, it will remain disabled even after the fault has been cancelled.

### 3.2 - MOTOR SUPPLIED, BUT NOT TORQUE

- Check that the **Maximum current** and **Rated current** parameters have no zero value.

### 3.3 - SHAFT LOCKED, ERATIC OSCILLATIONS OR ROTATION AT MAXIMUM SPEED

- Check the resolver wiring on the X1 connector and the mechanical mounting of the resolver on the motor.
- Check the value of the motor parameters (number of pole pairs, resolver adjustment, motor phase).

### 3.4 - DISCONTINUOUS MOTOR ROTATION WITH ZERO TORQUE POSITIONS

- Check the connection of the three phase cables between motor and amplifier.

### 3.5 - LOUD CRACKLING NOISE IN THE MOTOR AT STANDSTILL

- Check that the Motor - Amplifier - NC ground connections are in conformity with the [recommendations of chapter 4](#).

### 3.6 - LOUD NOISE IN THE MOTOR AT STANDSTILL AND WHEN RUNNING

- Check the rigidity of the mechanical transmission chain between motor and load (backlash and elasticity in the gearboxes and couplings).
- Execute again the **AUTOTUNING** command by choosing a lower bandwidth (**Medium** or **Low**).

### 4 - SERVICE AND MAINTENANCE

When exchanging an amplifier on a machine, proceed as follows:

- Check that the new amplifier has the same hardware configuration as the old one (including its address),
- Plug in the **parameter EEPROM** (or a copy of it) of the old amplifier on the new one,

**The new amplifier is then configured like the old one.**

## Chapter 8 - Appendix

### 1 - HARDWARE ADJUSTMENTS

All hardware adjustments of the SMT- BD1 amplifier module are located on the [hardware location diagram see next page](#)).

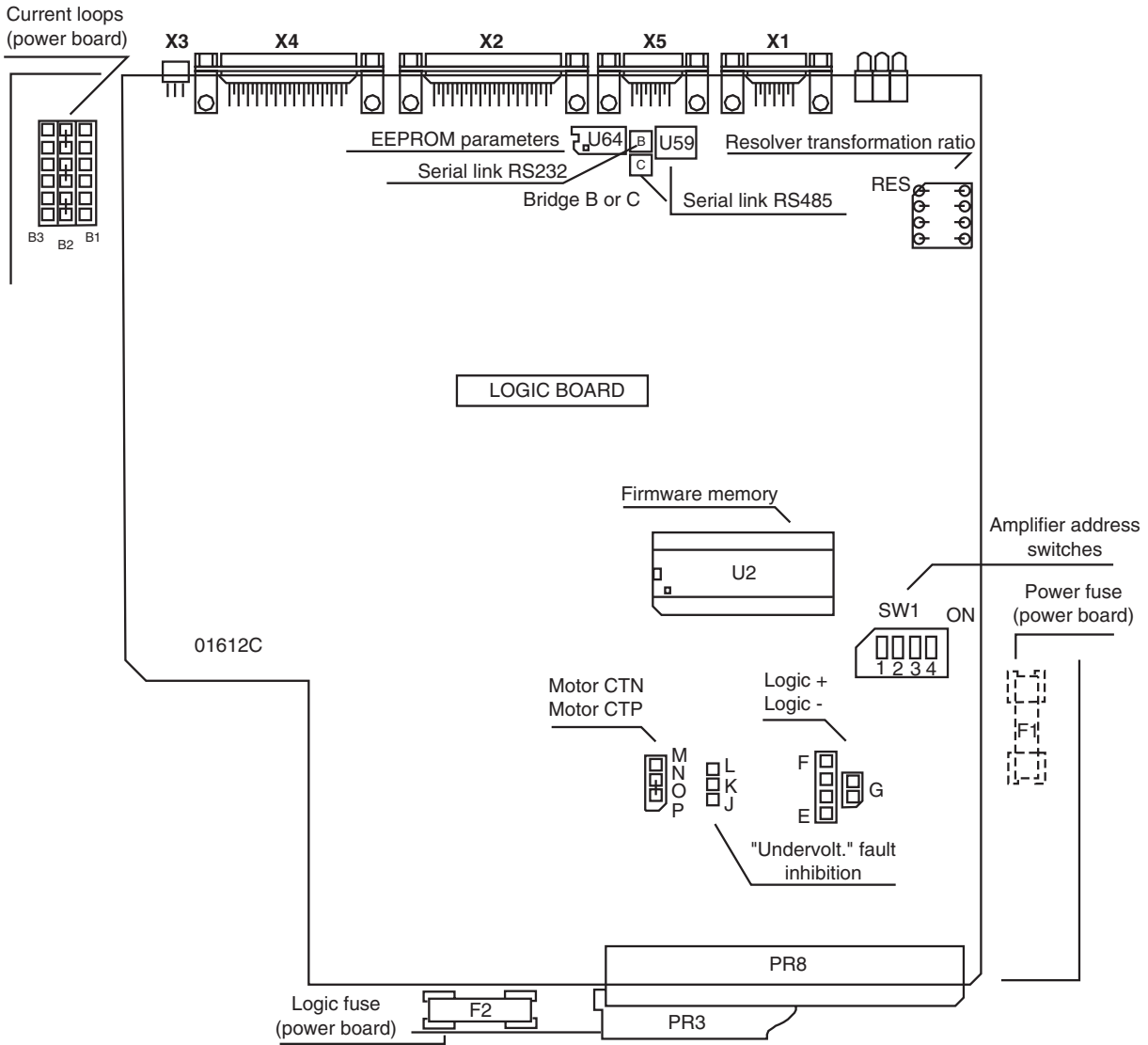
For the **MAVILOR** motor series **BL** and **MA**, the current loop adjustments are made by means of the **B1**, **B2**, **B3** jumpers.

Amplifier Motor	4 A	8 A	12 A	17 A	30 A	45 A	60 A	70 A	100 A
MA 3		B1							
MA 6		B1	B1						
MA 10		B2	B1	B1	B1				
MA 20		B2	B1	B1	B1	B1	B1		
MA 30				B2	B2	B2	B1	B1	
MA 45					B2	B2	B1	B1	B1
MA 55						B2	B2	B2	B1
BL 55-3	B1								
BL 55-5	B1								
BL 71		B2							
BL 72		B2	B1	B1					
BL 73		B2	B2	B1					
BL 74		B2	B2	B1					
BL 111		B1	B1						
BL 112		B2	B2	B1	B2				
BL 113		B3	B3	B2	B2	B2			
BL 114				B3	B3	B2	B2		
BL 115				B3	B3	B2	B2	B2	
BL 141				B2	B2	B2	B1	B1	
BL 142				B3	B3	B2	B2	B1	
BL 143				B3	B2	B2	B1	B1	B1
BL 144				B2	B2	B2	B1	B1	B1

In standard, the serial link is the RS 232 link, (jumper B closed). In option, the amplifier can be delivered with a RS 485 serial link, with jumper C closed.

The amplifier **Firmware memory** of the CAN amplifier version (option "h") is "**x.x2**".

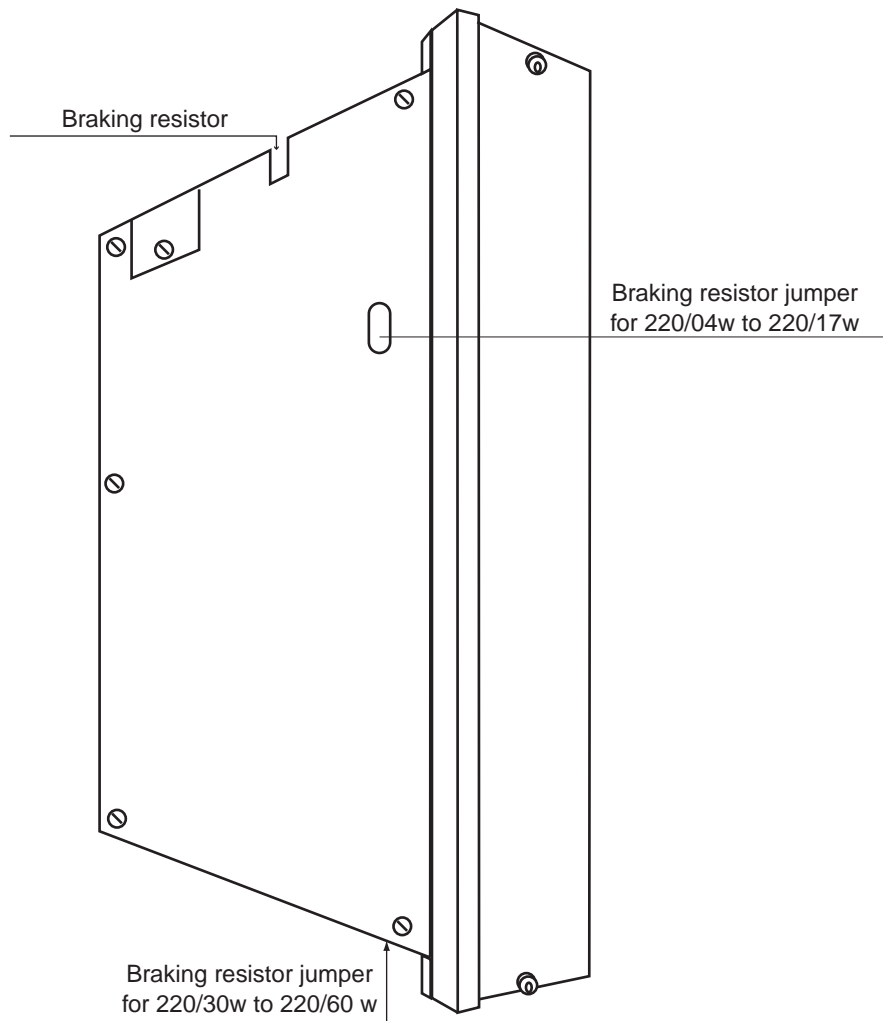
### HARDWARE LOCATION DIAGRAM



**FOR AMPLIFIER RATINGS 4 A TO 100 A**



**For amplifier versions with 70 A and 100 A current ratings in 220 V and serial numbers lower than 260600, please contact INFRANOR.**

**BRAKING SYSTEM SELECTION ON SMT-BD1-220/01w to 220/60w**

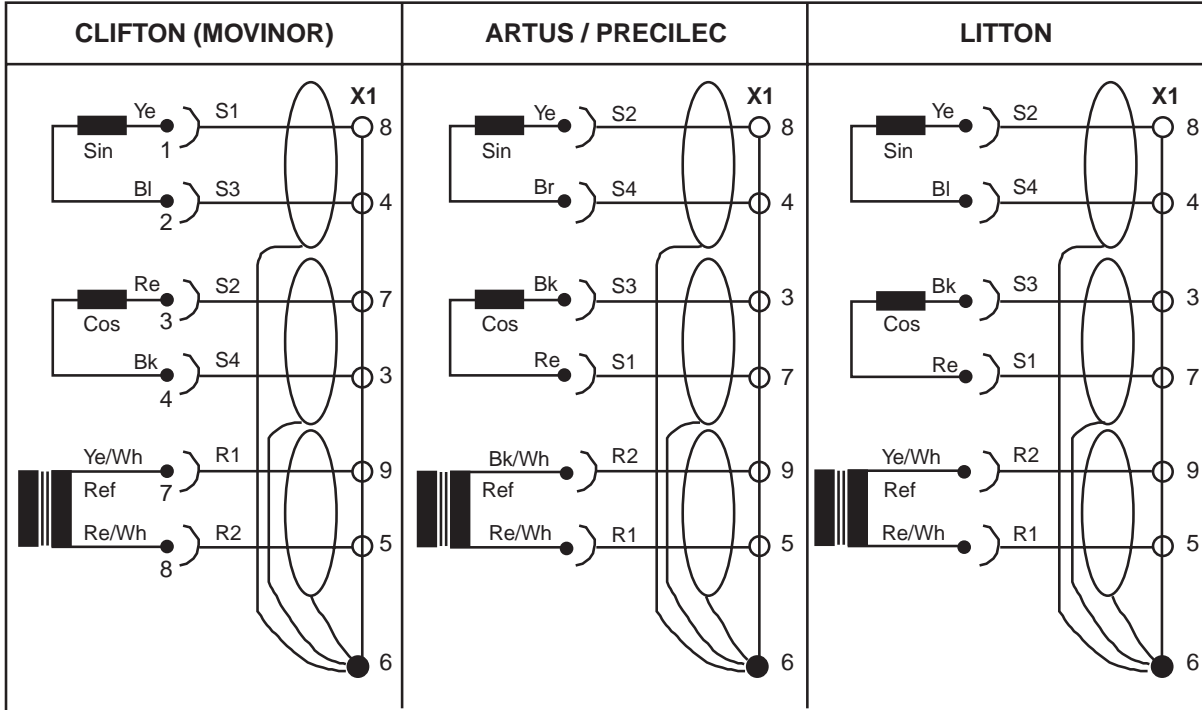
SMT-BM 20 A single-axis rack: Braking resistor jumper closed.  
BF rack: Braking resistor jumper open.

**NOTE**

This braking resistor system selection is only available on "w" referenced amplifiers.

## 2 - RESOLVER CONNECTIONS

For the use of **resolvers** others than the TAMAGAWA resolvers (MAVILOR motors), see following wiring diagrams of the **X1** connector:



Bk = black      Re = red  
 Bl = blueWh = white  
 Br = brown      Ye = yellow

For the use of **resolvers** with **transformation ratios** others than 0,5, the Cos and Sin signal amplitude must be adjusted by means of the "P-RES" components according to the table below:

Transformation ratio	P-RES			
	0,3	0,45	0,5	1
A - B - C - D (tolerance < 1 %)	21 K	14,3 K	12,7 K	6,34 K

It may be sometimes necessary, for some resolvers, to adjust the phase shift between the Reference and the Cos and Sin signals, by means of the capacitor "C60". This adjustment is made by INFRANOR.

### NOTE

When using resolvers with a number of pole pairs  $N > 1$ , all speed values displayed in the amplifier are equal to  $N$  times the motor rotation speed.



### 3 - MOTOR CONNECTIONS

#### 3.1 - MOTOR THERMAL SENSOR

For motors where the **thermal sensor** output is on the **resolver connector**, the thermal switch is connected to the **X1** connector (terminals 1 and 2). On **motors** where the **thermal sensor** output is on the **power connector**, the thermal switch can be connected via the **rack back panel** (see [RACK manual](#)).

On motors with an **NTC thermal sensor** (contact closes at the triggering), the amplifier configuration is the following: **OP** jumper closed and **MN** jumper open.

On motors with a **PTC thermal sensor** (contact opens at the triggering) the amplifier configuration is the following: **MN** jumper closed and **OP** jumper open.

#### 3.2 - CURRENT LOOPS

The adjustment of the current loop **P.I. regulators** according to the **amplifier current ratings** and to the **inductance between the motor terminals** is made as follows:

##### 4 A, 8 A, 12 A AND 17 A AMPLIFIERS

- Calculation of **G = 1,4. Amplifier current (A) . Inductance between phases (mH)**,
- If **G < 60**, current loop jumpers (x3) on **B3** position,
- If **60 < G < 100**, current loop jumpers (x3) on **B2** position,
- If **G > 100**, current loop jumpers (x3) on **B1** position.

##### 30 A, 45 A, 60 A, 70 A AND 100 A AMPLIFIERS

- Calculation of **G = 1,4. Amplifier current (A) . Inductance between phases (mH)**,
- If **G < 100**, current loop jumpers (x3) on **B3** position,
- If **100 < G < 250**, current loop jumpers (x3) on **B2** position,
- If **G > 250**, current loop jumpers (x3) on **B1** position.

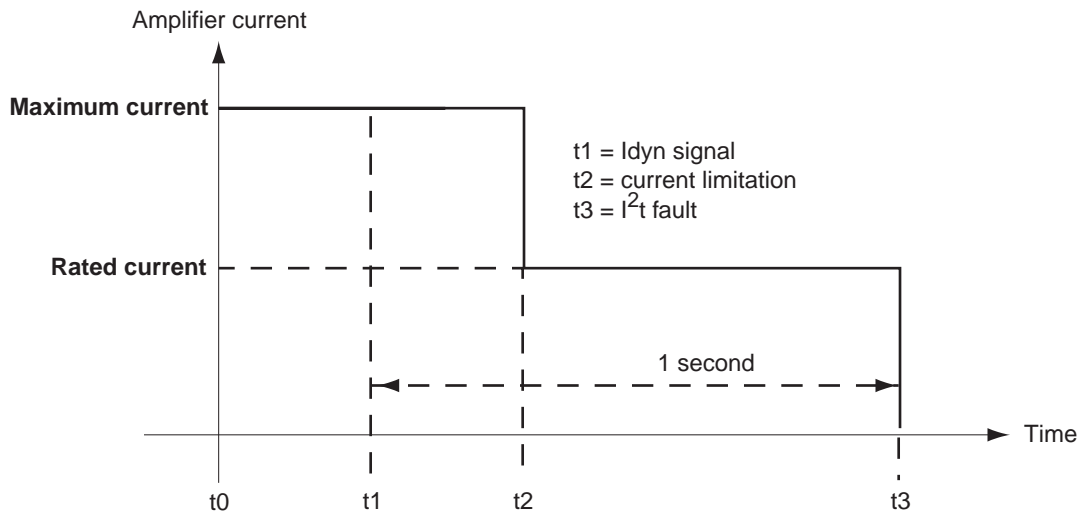
#### 3.3 - I<sup>2</sup>T PROTECTION

##### Current limitation in Fusing mode

When the amplifier RMS current ( $I^2t$ ) reaches 85 % of the **Rated current**, the  $I^2t$  error display is flashing on the amplifier front panel. If the RMS current ( $I^2t$ ) has not dropped below 85 % of the **Rated current** within 1 second, the  $I^2t$  fault is released and the amplifier is disabled (otherwise, the flashing  $I^2t$  error display is cancelled).

When the amplifier RMS current ( $I^2t$ ) reaches the **Rated current** value, the  $I^2t$  protection limits the amplifier current to this value.

The amplifier current limitation diagram in an extreme case (motor overload or locked shaft) is shown below.



The maximum current duration before the flashing display depends on the value of the **Rated current** and **Maximum current** parameters. This value is calculated as follows:

$$T_{\text{dyn}}(\text{second}) = t_1 - t_0 = 200 \cdot \frac{\text{rated current } (\%)}{\text{max. current } (\%)}$$

The maximum current duration before the limitation to the rated current also depends on the value of the **Rated current** and **Maximum current** parameters. This value is calculated as follows:

$$T_{\text{max}}(\text{second}) = t_2 - t_0 = 240 \cdot \frac{\text{rated current } (\%)}{\text{max. current } (\%)}$$

#### NOTE

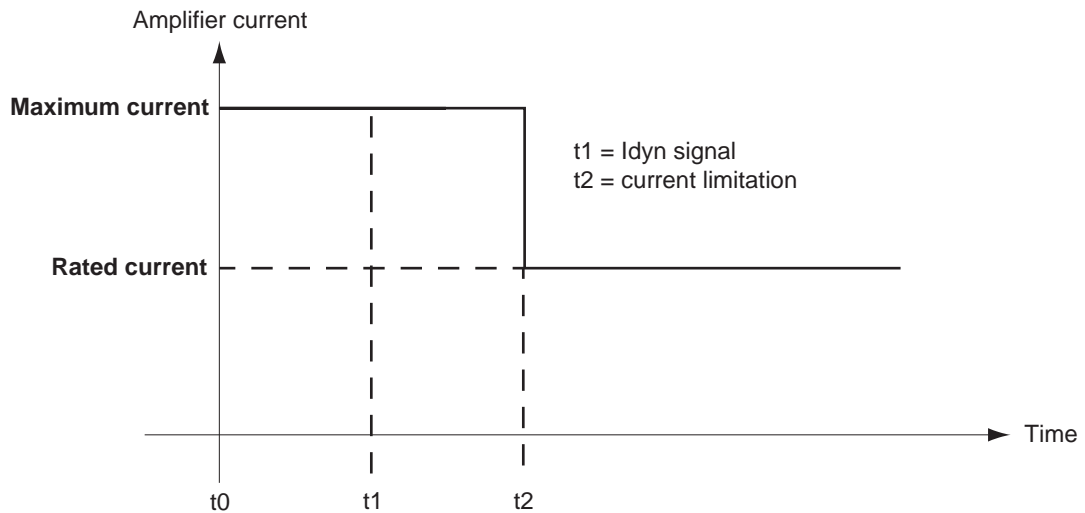
When the **Maximum current** / **Rated current** ratio is close to 1, the values of  $T_{\text{dyn}}$  and  $T_{\text{max}}$  calculated above are quite below the real values. But this formula remains very precise as long as the **Maximum current** / **Rated current** ratio is higher than 3/2.

#### Current limitation in Limiting mode

When the amplifier RMS current ( $I^2t$ ) reaches 85 % of the **Rated current**, the  $I^2t$  error display is flashing on the amplifier front panel. When the RMS current ( $I^2t$ ) drops below 85 % of the **Rated current**, the flashing  $I^2t$  error display is cancelled.

When the amplifier RMS current ( $I^2t$ ) reaches the **Rated current** value, the  $I^2t$  protection limits the amplifier current to this value.

The amplifier current limitation diagram in an extreme case (motor overload or locked shaft) is shown below.

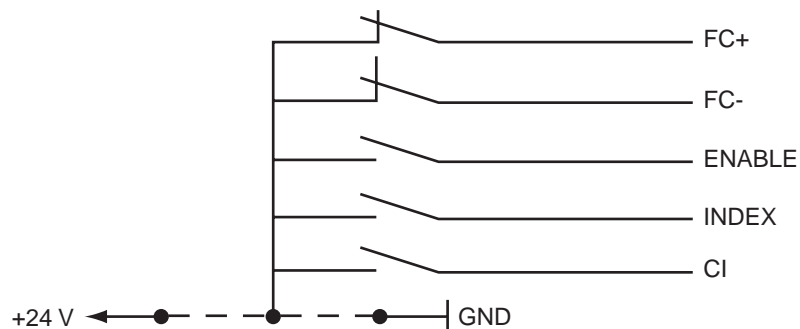


The maximum current duration before the release of the  $I_{dyn}$  signal output ( $t_1 - t_0$ ) and before the rated current limitation ( $t_2 - t_0$ ) is calculated the same way as for the **Fusing** mode.

#### 4 - LOGIC CONTROL ADJUSTMENT

##### 4.1 - POSITIVE OR NEGATIVE LOGIC INPUTS

The logic inputs **FC+**, **FC-**, **ENABLE**, **INDEX** and **CI** of the logic connector **X4** can be configured in positive logic (control by +24 V) or in negative logic (control by 0 V) as described below:



POSITIVE LOGIC: E-F-G jumpers closed  
 Input impedance: 4,7 k $\Omega$

Range: active at level  $5 < V < 30$  V  
 Response time: 500  $\mu$ s (except for CI: 20  $\mu$ s)

NEGATIVE LOGIC: E-F-G jumpers open  
 Input impedance: 4,7 k $\Omega$

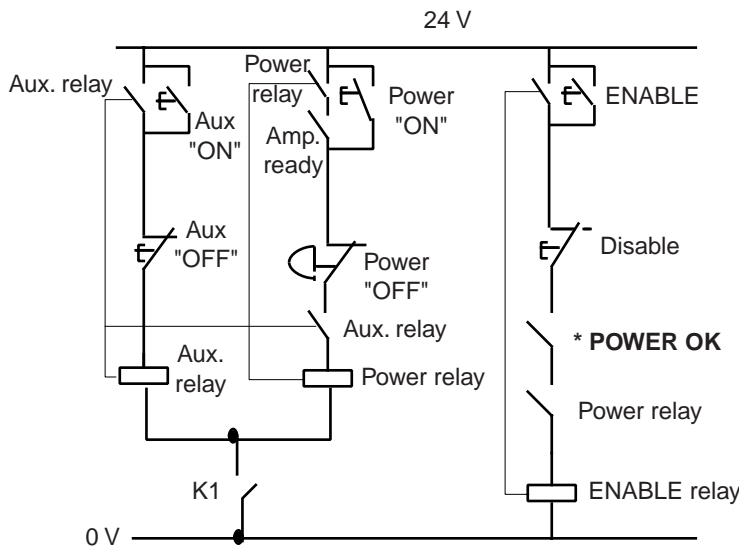
Range: inactive or open at level  $5 < V < 30$  V  
 Response time: 500  $\mu$ s (except for CI: 20  $\mu$ s)

#### REMARK

The five inputs (**FC+**, **FC-**, **ENABLE**, **INDEX**, **CI**) of the **X4** connector must **all** be in positive logic, or **all** in negative logic.

4.2 - USE OF THE « AMP. READY » AND « POWER READY » OUTPUTS

- If the position initialization references must be kept when a stored fault is released on the amplifier or at power supply cut-off, it must be possible:
  - \* to reset the faults via pin 13 of X4 without interrupting the logic supply,
  - \* to have a logic supply independent from the power supply (auxiliary supply) in order to be able to switch off the power supply without switching off the logic supply.
  
- If the amplifier has an auxiliary supply on the PR8 connector, that is independent from the power supply, the **IJK** jumper of the power board allows to inhibit or to release the "Undervolt." fault when switching on the auxiliary supply before switching on the power supply.
  - \* **JK jumper closed and KL jumper open.** When turning on the auxiliary supply before the main power supply, the "Undervolt." fault is displayed and can hide a fault of lower priority. The "AMP READY" and "POWER READY" outputs are both inactive (contact is open) until the power supply is on.
  - \* **JK jumper open and KL jumper closed.** The "Undervolt." fault is inhibited when turning on the auxiliary supply before switching on the main power supply. The "AMP READY" output is then active and "POWER READY" remains inactive (contact open) until the main power supply is on. In this case, the amplifier control must have following relay logic:

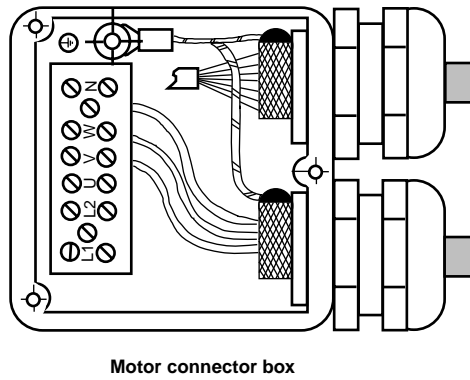
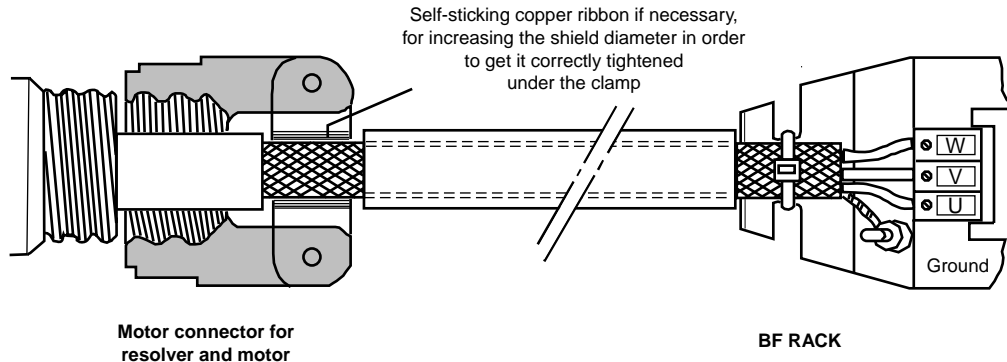


Amp ready	"Amp ready" signals of all axes
Power ready	"Power ready" signals of all axes
Power relay	Relay for power ON
Logic relay	Relay for logic ON
ENABLE Relay	Servo control relay
K.1	Auxiliary contact of the main isolation switch

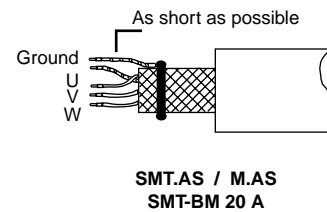
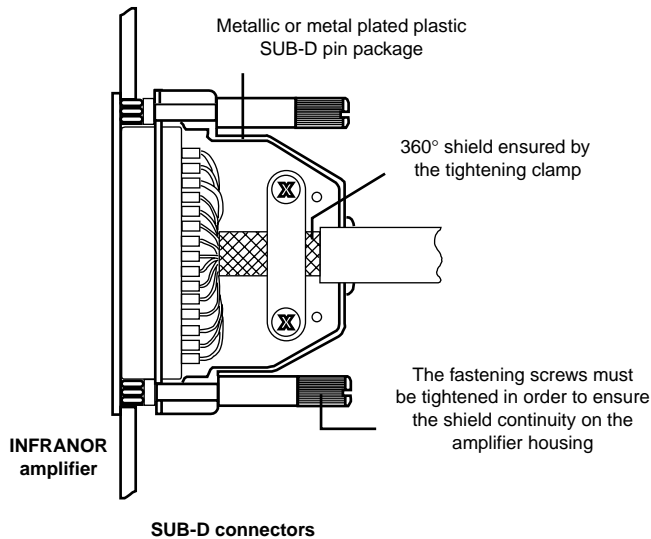
**5 - 360° SHIELD CONNECTION**

**RULE**

There must never be a shield interruption on the whole cable length.



The cable can be soldered on the shield because the connector box is metallic. This solution does not exactly meet the EMC requirements but it is acceptable.



**NOTE**

When the 360° shield is made by means of a clamp, it is not necessary to additionally connect a cable on the appropriate connection pin of the SUB-D connector.

## 6 - AMPLIFIER AND SOFTWARE TYPES

### 6.1 – ORDERING CODE

**SMT - BD1 / \_ h \_ - 220 / \_ \_ / \_ - T - BS \_**

1 = RS 232  
2 = RS 422/485

x = auxiliary encoder input

4 A to 100 A = amplifier current size

r = additional heatsink (18 TE)

w = braking resistor for single-axis rack

CT = cogging torque compensation

---

# ***PART TWO***

# ***CAN COMMUNICATION PROTOCOL***

---

# Contents part two

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# Chapter 1 - General description

Main characteristics :

- The rhythm of the data transfers is controlled by the NC up to 500 Hz.
- Axes synchronization per amplifier group and by means of synchro messages.
- Each amplifier has a switch defined address from 1 to 15 belonging to 2 possible synchro groups. The 0 address is assigned to the host of the network (the NC).
- Several possible control modes of the amplifier (speed / incremental position / absolute position).

The operation of this amplifier is governed by the messages exchanges on the CAN bus. There are 2 types of communication messages:

- synchronous messages,
- asynchronous messages.

The synchronous messages control the amplifier and the asynchronous messages allow the amplifier parameter setting.

## CAUTION

**This manual corresponds to the amplifier versions 6.02 and up, with following modifications:**

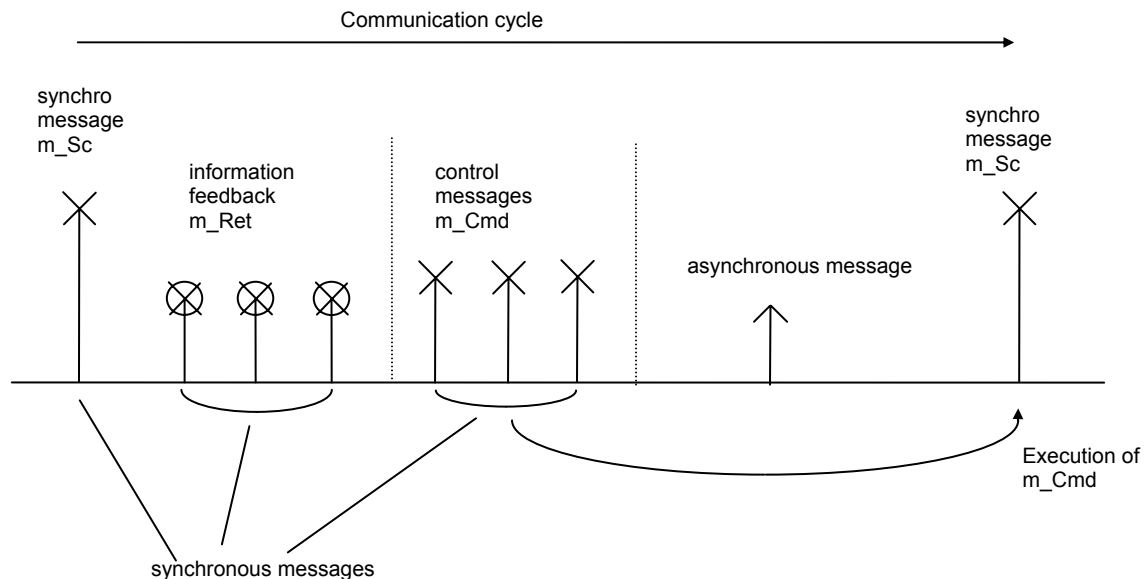
- [parameter 42](#) has been modified,
- [parameters 70, 87, 89 and 101](#) have been added.

## Chapter 2 - Synchronous messages

These are periodic messages such as position controls or position feedbacks. These messages control the amplifier.

There are 3 types of synchronous messages:

- synchro message (m\_Sc),
- control message (m\_Cmd),
- feedback message (m\_Ret).



At constant time intervals (cycle time), the NC sends a synchro message m\_Sc and the amplifiers of the same synchronization group acquire their position and send the messages containing their position (m\_Ret). After the reception of the positions, the NC sends the input command messages (m\_Cmd) to the amplifiers of this same synchro group.

### 1 - SYNCHRO MESSAGES

The synchro message contains no data. It synchronizes the various axes on the network and defines the data transfer rhythm.

There are 2 synchro groups defined by the amplifiers addresses:

- group 0 (G0) : addresses 1 to 7
- group 1 (G1) : addresses 8 to 15

The synchro message is emitted by the NC and is received by all amplifiers of a same group.

There are 2 types of synchro messages:

- Control synchro m\_Sc: this message triggers:
  - the returning of the information feedback message (m\_Ret) if it has been programmed,
  - the taking into account of the input command (m\_Cmd) transmitted before.
- Feedback synchro m\_Sr:
  - The feedback synchro message triggers the returning of the information feedback message (m\_Ret).

This message makes it possible to get position feedbacks at a rhythm different from the one of the controls.

There is one control synchro message and one feedback synchro message for each amplifier group.

## 2 - CONTROL MESSAGES

There is one control message per axis. In this message, it is possible to define, for each axis:

- an absolute position input command (32 bits) or an incremental position input command (16 bits),
- a speed input command,
- a torque input command.

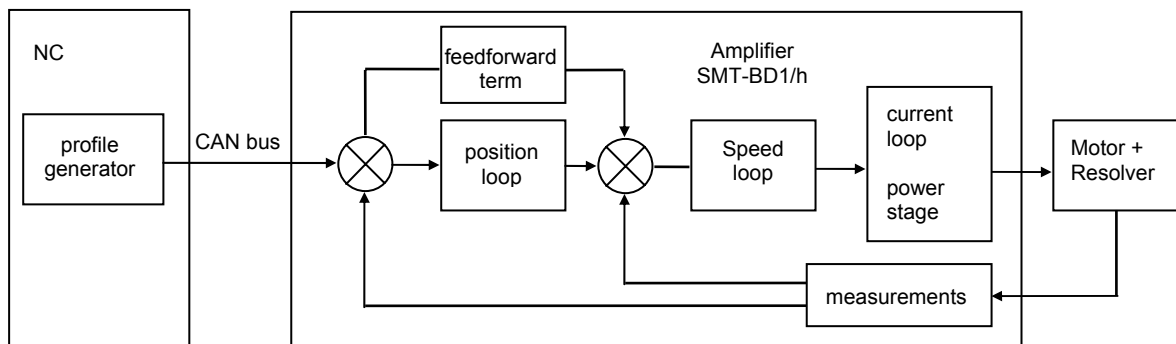
### Position input command mode

In this mode, the amplifiers periodically receive the position input command by the NC. The profile generator is in the NC; this allows the axes synchronization.

The amplifier cycle time is 500  $\mu$ s. The position input command interpolation is linear.

The position input command can be:

- absolute (32 bits),
- or incremental (16 bits).



### NOTE

The position feedback is optional. This allows to reduce the traffic on the bus.

### Double command

There is also a particular mode for the absolute position input command:

- In this mode, a control message can contain 2 absolute position input commands for 2 amplifiers.
- The addresses of both amplifiers must be sequential. For the first amplifier which address is [ABC0], the control is in the bytes 1 to 4 of the message. For the second amplifier which address is [ABC1], the control is in the bytes 5 to 8 of the message.
- This mode makes it possible to reduce the number of messages used.

## 3 - FEEDBACK MESSAGES

There is one feedback message per axis. In this message, it is possible to define, for each amplifier:

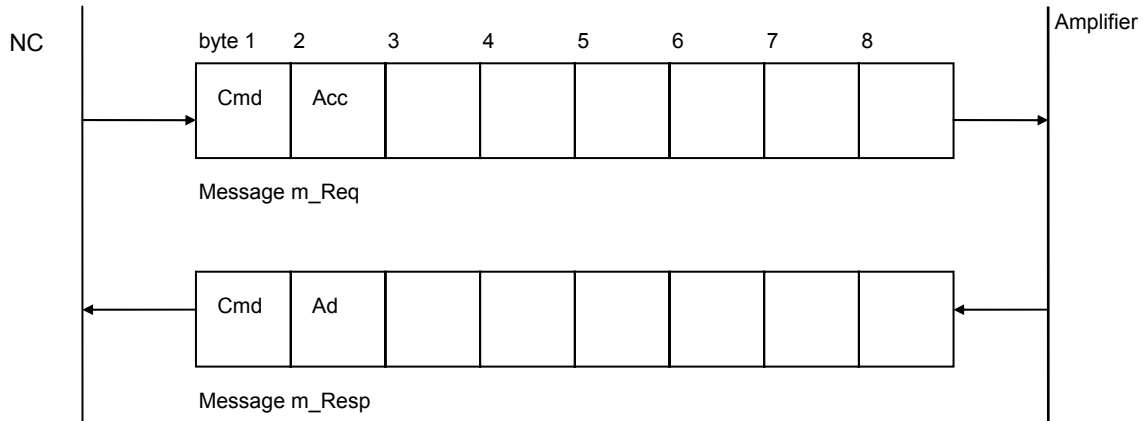
- an absolute position feedback (32 bits) or an incremental position feedback (16 bits),
- a speed monitor,
- a torque monitor,
- an amplifier error code.

## Chapter 3 - Asynchronous messages

These messages are used for the parameter transmission between NC and amplifiers.

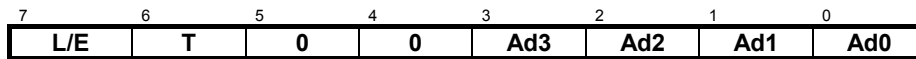
### 1 - STRUCTURE OF THE MESSAGES

- The master sends a message m\_Req in order to initialize a transfer. The transfer direction is defined by the bit L/E.
- The appropriate slave answers with a message m\_Resp, except for the case where bit T = 1 (see diagram below).



#### Message m\_Req :

Byte 1: Transfert command  
Octet 2: access mode:



L/E = 0 Reading of a parameter

L/E = 1 Writing of a parameter

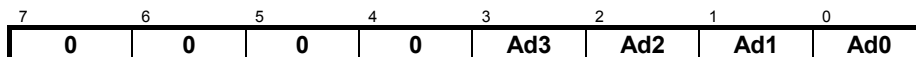
T = 0 Concerns one single amplifier which address is defined by "Ad3 Ad2 Ad1 Ad0".

T = 1 All axes are concerned. "Ad3 Ad2 Ad1 Ad0" are not taken into account.

Bytes 3 to 8: parameters.

#### Message m\_Resp :

Byte 1: Transfert command  
Byte 2: address of the questioned amplifier:



"Ad3, Ad2, Ad1, Ad0" : slave address (amplifier).

Bytes 3 to 8: parameters.

#### NOTE

In the case of 16 or 32 bit datas, the low weight bytes are stored before the high weight bytes.

## 2 - LIST OF THE PARAMETER TRANSFER COMMANDS

### NOTES:

- 1 word = 2 bytes.
- All parameter setting commands are not buffered.
- The execution time of a command is about 1 to 2 ms (except for procedures which execution time is not known in advance).
- During the execution of a procedure, the execution of another command can be delayed.

### 2.1 - OPERATION PARAMETERS

#### Amplifier mode

<i>Command</i>	<b>40</b> (0x28)
	defines the amplifier operation mode (position / speed or torque).
<i>Parameters</i>	1 byte.
	1 torque mode
	2 speed mode with PI regulator
	4 position mode
	8 speed mode with P regulator
	16 speed mode with PI <sup>2</sup> regulator
<i>Conversion</i>	
<i>Limitation</i>	
<i>Execution</i>	During the execution of this command, the amplifier must generally be disabled. Only the switching on to torque mode or from torque mode can be made with enabled amplifier. The torque input command must be available (see configuration of control and feedback messages - Command 42).
<i>Remarks</i>	

#### Cycle time

<i>Command</i>	<b>41</b> (0x29)
	defines the cycle time of the NC. This value is necessary for the interpolation of the position input command.
<i>Parameters</i>	1 word. This value is in $\mu$ s and is between 1000 and 20000.
<i>Conversion</i>	
<i>Limitation</i>	
<i>Execution</i>	Amplifier disabled.
<i>Remarques</i>	

#### Configuration of the command and feedback message

<i>Command</i>	<b>42</b> (0x2A)
	defines the command (m_Cmd) and feedback (m_Ret) messages configuration.
<i>Parameters</i>	2 bytes.
	<u>The 2 first bytes:</u>

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	TR	FR	SR	0	PR	AR	DR	EF	TF	0	SF	CF	PF	AF	F

TR	torque input command (16 bits) in torque mode.
FR	speed feedforward.
SR	speed input command (16 bits) in speed mode.
PR	position input command in position mode (absolute or incremental).
AR	absolute position input command (32 bits).
DR	double position input command (absolute 32 bits).
EF	amplifier status feedback (16 bits).
TF	current monitor feedback (16 bits).
SF	speed monitor feedback (16 bits).
CF	position feedback by external encoder instead of the resolver.
PF	position feedback (absolute or relative).
AF	absolute position feedback 32 bits.
F	authorizes a feedback message (m_Ret) in response to a command synchro message (m_ScGx).

The position input command and feedback are applied by means of the same scale factor (see command 50). The maximum position value depends on the position resolution =  $-32768 \times$  Resolution at  $32767 \times$  Resolution.

Input command:	bit 10 (PR)	bit 9 (AR)	
Feedback:	bit 2 (PF)	bit 1 (AF)	
	1	0	relative position 16 bits
	1	1	absolute position 32 bits
	0	1	absolute position 16 bits
	0	0	no position

Bit DR allows to define 2 32 bits position input commands for 2 amplifiers in the same message, or 4 16 bits position input commands for 4 amplifiers in the same message.

The amplifiers addresses must be .

32 bits position:

For the first amplifier which address is [Ad3 Ad2 Ad1 0], the command is contained in bytes 1 to 4 of the message.

For the second amplifier which address is [Ad3 Ad2 Ad1 1], the command is contained in bytes 5 to 8 of the message.

16 bits position:

For the first amplifier which address is [Ad3 Ad2 0 0], the command is contained in bytes 1 and 2.

For the second amplifier which address is [Ad3 Ad2 0 1], the command is contained in bytes 3 and 4.

For the third amplifier which address is [Ad3 Ad2 1 0], the command is contained in bytes 5 and 6.

For the fourth amplifier which address is [Ad3 Ad2 1 1], the command is contained in bytes 7 and 8.

The speed command and feedback vary between -32768 and 32767 and correspond to the maximum application speed defined by [command 61](#).

The torque command and feedback vary between -32768 and 32767 and correspond to the maximum current defined by [command 76](#).

When bit FR is set at 1, the regulator uses the speed input command (this must be programmed in the same message) as feedforward term instead of the one calculated by the regulator (see [drawing in manual SMT-BD1/h, part 2, chapter 3, section 2.4](#)).

When bit CF is set at 1, the position feedback sent by the message m\_Ret is the position given by the external encoder and not the resolver position.

The amplifier status is defined as follows :

Bit (0-15)	Meaning
0	Amplifier fault
1	FC+
2	FC-
3	CI
4	INDEX
5	ENABLE
6	Amplifier enabled
7	Auto-tuning procedure
8	Index research procedure
9	Procedure execution
10	Procedure cancelled
11	Procedure has succeeded
12	Procedure ended because of an error
13	Position captured on transition inactive-active of CI
14	Position captured on transition active-inactive of CI
15	

Bits 13 and 14 indicate that a motor position captured by the transition of the CI input is memory stored. The reading of this position by the [commands 66 and/or 67](#) resets these bits at 0.

<i>Limitation</i>	The number of bytes for this command or feedback message is 8. The configuration of these messages must take into account this limitation. When a synchro message (command or feedback) contains several information (position, speed, current...), the sequence of these information in the message - if they are there - is: - position - speed - current - status
<i>Execution</i>	Whith disabled amplifier.
<i>Remarques</i>	

#### Error threshold of the CAN bus

---

<i>Command</i>	<b>43</b> (0x2B) defines the time after which the amplifier triggers the CAN reference error when the control synchro message (m_Sc) or the input command message (m_Cmd) are missing.
<i>Parameters</i>	1 word. The recommended value is 500 or 1000.
<i>Conversion</i>	The parameter value corresponds to the time in $\mu$ s.
<i>Limitation</i>	
<i>Execution</i>	
<i>Remarks</i>	

#### Position resolution

---

<i>Command</i>	<b>50</b> (0x32) defines the position resolution (ppr).
<i>Parameters</i>	1 word.
<i>Conversion</i>	
<i>Limitation</i>	From 513 to 32767, except for the value 0 which corresponds to a resolution of 65536 (full scaling).
<i>Execution</i>	Amplifier disabled.
<i>Remarks</i>	This position resolution consequently defines the position input command and position feedback format.

#### Hardware configuration

---

<i>Command</i>	<b>51</b> (0x33)												
<i>Parameters</i>	1 word. Indicates the optional amplifier configuration.												
	<table> <thead> <tr> <th>Bit (0-15)</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Non volatile RAM (option CT-EMF)</td> </tr> <tr> <td>3</td> <td>RAM (always at 1 if bit 0 is at 1)</td> </tr> <tr> <td>4</td> <td>Option "auxiliary encoder input"</td> </tr> <tr> <td>5</td> <td>Option "logic inputs/outputs"</td> </tr> <tr> <td>7</td> <td>CAN interface available (always at 1)</td> </tr> </tbody> </table>	Bit (0-15)	Meaning	0	Non volatile RAM (option CT-EMF)	3	RAM (always at 1 if bit 0 is at 1)	4	Option "auxiliary encoder input"	5	Option "logic inputs/outputs"	7	CAN interface available (always at 1)
Bit (0-15)	Meaning												
0	Non volatile RAM (option CT-EMF)												
3	RAM (always at 1 if bit 0 is at 1)												
4	Option "auxiliary encoder input"												
5	Option "logic inputs/outputs"												
7	CAN interface available (always at 1)												
<i>Conversion</i>													
<i>Limitation</i>	Reading only												
<i>Execution</i>													
<i>Remarks</i>													

#### Version

---

<i>Command</i>	<b>52</b> (0x34)
<i>Parameters</i>	6 bytes. 1 word : version number of the amplifier software. 4 bytes : identification code of the manufacturer: (INFR) for Infranor.
<i>Conversion</i>	
<i>Limitation</i>	Reading only.
<i>Execution</i>	
<i>Remarks</i>	

## Amplifier status

---

**Command** 53 (0x35)

**Parameters** 3 words

1st word: Amplifier fault.

Bit (0-15)	Fault
1	It
2	Resolver-digital conversion
3	Position following error
4	EEPROM
5	CAN input command
7	Procedure execution error
9	Power stage fault : - power overvoltage, - short-circuit, - IGBT module overheating
10	Resolver cables interrupted
11	Power undervoltage.
12	Amplifier thermal probe.
13	Motor thermal probe.

2nd word: Statement of the amplifier logic inputs.

Bit (0-15)	Meaning
3	Encoder input marker pulse statement 0 = positive logic. 1 = negative logic.
4	0 = FC+ off 1 = FC+ on
5	0 = FC- off 1 = FC- on
6	0 = CI off 1 = CI on
7	0 = Index off 1 = Index on
8	0 = ENABLE off 1 = ENABLE on
12	0 = Amplifier off 1 = Amplifier on
14	1 = A position is captured by the Inactive-Active transition of the CI input
15	1 = A position is captured by the Active-Inactive transition of the CI input

3rd word: indicates the statement of a procedure.

A procedure is an action of the amplifier during which the amplifier does not answer the NC input command.

A procedure is executed by the amplifier in an autonomous way.

Bit (0-15)	Meaning
0	Auto-phasing procedure phase 1
1	Auto-phasing procedure phase 2
2	Cogging torque acquisition procedure phase 1
3	Cogging torque acquisition procedure phase 2
4	Auto-tuning procedure
5	Index research procedure
8	EEPROM saving procedure
9	Encoder output programming procedure
13	Procedure cancelled
14	Procedure correctly executed
15	Procedure over because of an error

**Conversion**

**Limitation**

**Execution**

Reading only.



**Remarks** When a procedure is called, the bits 13, 14 and 15 of the procedure status are set at 0. During the procedure execution, the corresponding bit is set at 1. At the end of the procedure, this bit is reset at 0, and one or two of bits 13, 14, 15 are set at 1.

The amplifier fault RESET command ([command 93](#)) allows to cancel any procedure during its execution.

If the amplifier is disabled after a fault, the fault RESET command cancels the fault but does not enable the amplifier. To enable the amplifier, use [command 91 "ENABLE"](#).

### Speed/current monitor

---

**Command** 54 (0x36)

**Parameters** 2 words

1 word: speed monitor.  
1 word: current monitor.

**Conversion**

**Limitation** Lecture uniquement.

**Execution**

**Remarks** The formats of the speed monitor or the current monitor are 16 bits full scaling, that is 32767 for maximum speed (defined by [command 61](#) : max. application speed) or maximum current (defined by the amplifier sizing). These formats are also used for the speed and current input commands.

### Masking of the amplifier faults

---

**Command** 55 (0x37)

**Parameters** 1 word.

Each bit of this word is corresponding to an amplifier fault. The meaning of these bits is given by [command 53](#).

Bit = 0: the corresponding fault is masked.

Bit = 1: the fault will disable the amplifier.

**Conversion**

**Limitation** Only the following error and CAN input command faults can be masked.

**Execution**

**Remarks** When an error has occurred and when the corresponding fault is masked by this command, the amplifier is not stopped, but only the fault is displayed ([command 53 "amplifier status"](#)).

### Logic inputs/outputs

---

**Command** 56 (0x38)

Allows the reading of the logic inputs or the writing of the logic outputs of X2.

**Parameters** 1 word.

In writing: bits 0 to 3 are corresponding to the logic outputs LOUT0 to LOUT3.

In reading: bits 0 to 5 are corresponding to the logic inputs LIN0 to LIN5. When the option "auxiliary encoder input" is available ([command 51](#)), the logic inputs 0 and 1 are not available.

**Conversion**

**Limitation**

**Execution**

**Remarks** For the logic inputs / outputs, see [Part 1 of this manual, chapter 3, section 3](#): "X2 encoder connector".

### Reversal of the rotation direction

---

**Command** 60 (0x3C)

This command allows the reversal of the rotation direction with regard to the input command. It also reverses the position feedback.

The second byte allows to reverse the position counting of the encoder input, if available.

**Parameters** 1st byte.

=0 : normal.

≠0 : inversed.

2nd byte

=0 : normal.

≠0 : inversed

**Conversion**

**Limitation**

**Execution**

**Remarks**

Amplifier disabled.

### Maximum application speed

---

<i>Command</i>	<b>61</b> (0x3D) defines the maximum speed (as well as the speed scaling) of the application.
<i>Parameters</i>	1 word.
<i>Conversion</i>	For getting the speed in rpm: x 1.8310546875
<i>Limitation</i>	This parameter varies between 55 (100 rpm) and 7446 (14000 rpm)
<i>Execution</i>	Amplifier disabled
<i>Remarks</i>	

### Absolute position measurement

---

<i>Command</i>	<b>62</b> (0x3E) Allows the reading of the motor position.
<i>Parameters</i>	32 bits.
<i>Conversion</i>	See position resolution.
<i>Limitation</i>	Reading only
<i>Execution</i>	
<i>Remarks</i>	

### Position reset

---

<i>Command</i>	<b>63</b> (0x3F) Resets the position sent back by the amplifier.
<i>Parameters</i>	
<i>Conversion</i>	
<i>Limitation</i>	Writing only.
<i>Execution</i>	Amplifier disabled.
<i>Remarks</i>	

### Reading of the position error

---

<i>Command</i>	<b>64</b> (0x40) Allows the reading of the position error.
<i>Parameters</i>	32 bits.
<i>Conversion</i>	See position resolution.
<i>Limitation</i>	Reading only.
<i>Execution</i>	
<i>Remarks</i>	

### Position error threshold

---

<i>Command</i>	<b>65</b> (0x41) Defines the position error triggering threshold.
<i>Parameters</i>	1 word.
<i>Conversion</i>	See position resolution.
<i>Limitation</i>	
<i>Execution</i>	
<i>Remarks</i>	

### Reading of the position captured on inactive-Active transition

---

<i>Command</i>	<b>66</b> (0x42) Allows to read the value of the motor position captured by the Inactive-Active transition of the CI input (pin 4 of the X4 connector).
<i>Parameters</i>	Position: 32 bits. Capture indicator: 16 bits.
<i>Conversion</i>	See position resolution.
<i>Limitation</i>	Reading only.
<i>Execution</i>	
<i>Remarks</i>	Bit 0 of the indicator indicates if the position has just been captured; this bit will be reset at 0 by the amplifier after the reading. This bit is the same as bit 13 of the amplifier status in the synchronous message feedback (see also <a href="#">command 42</a> ). If the CI input is configured in positive logique (see <a href="#">Part 1 of the manual, chapter 8, section 4.1</a> ), the Active-Inactive transition corresponds to the rising edge of the signal. The active level duration must be higher than 50 µs.

### Reading of the position captured on Active-Inactive transition

---

<i>Command</i>	<b>67</b> (0x43) Allows to read the value of the motor position captured by the Active-Inactive transition of the CI input (pin 4 of the X4 connector).
<i>Parameters</i>	Position: 32 bits. Capture indicator: 16 bits.
<i>Conversion</i>	See position resolution.
<i>Limitation</i>	Reading only.
<i>Execution</i>	
<i>Remarks</i>	Bit 0 of the indicator indicates if the position has just been captured; this bit will be reset at 0 by the amplifier after the reading. If the CI input is configured in positive logique (see <a href="#">Part 1 of the manual, chapter 8, section 4.1</a> ), the Active-Inactive transition corresponds to the falling edge of the signal. The inactive level duration must be higher than 50 $\mu$ .

### Filtering of the CI input

---

<i>Command</i>	<b>68</b> (0x44)
<i>Parameters</i>	1st word: filter parameter. 2nd word: acceptance threshold.
<i>Conversion</i>	1st word: x 50 $\mu$ s. 2nd word: see position resolution.
<i>Limitation</i>	
<i>Execution</i>	
<i>Remarks</i>	The first parameter defines the signal filter per 50 $\mu$ s pitch. This filter allows to cancel disturbing pulses. The signal duration must then be higher than this parameter x 50 $\mu$ s. This parameter can vary between 1 and 32767. The second parameter defines the minimum signal width (in position). This parameter can be 0 (no limitation) or between 1 and 32767 (same format than the position).

### Bandwidth

---

<i>Command</i>	<b>69</b> (0x45) This parameter defines the position error threshold in which the position loop is open.
<i>Parameters</i>	1 word
<i>Conversion</i>	See position resolution.
<i>Limitation</i>	
<i>Execution</i>	
<i>Remarks</i>	

### Absolute position input command

---

<i>Command</i>	<b>70</b> (0x46)
<i>Parameters</i>	2 words: absolute position input command in 32 bits.
<i>Conversion</i>	See position resolution ( <a href="#">parameter 50</a> ).
<i>Limitation</i>	
<i>Execution</i>	
<i>Remarks</i>	This command allows to initialize the absolute position input command. It is useful in relative position input command mode 16 bits or absolute position input command 16 bits; it is not interesting absolute position input command mode 32 bits. In absolute mode 16 bits, it is necessary, at power up, to read the amplifier absolute position in 32 bits ( <a href="#">parameter 62</a> ) and to then initialize the absolute input command (parameter 70) with the same value.

## 2.2 – MOTOR PARAMETERS

### Synchronous motor parameters

---

<i>Command</i>	<b>71</b> (0x47)
	defines the parameters necessary for the driving of a synchronous motor. These parameters can be calculated by the auto-phasing procedure.
<i>Parameters</i>	2 words + 1 byte. 1 word: Motor phase: corresponds to the phases order (U, V, W) of the motor connection. 1 word: Resolver adjustment: phase shift between resolver and motor rotor. 1 byte: Number of motor pole pairs (1 to 12).
<i>Conversion</i>	Motor phase: 2 possible values (0x5555 or 0xAAAA). Resolver adjustment: $5.4931640625e-3^*$ (number of pole pairs). The resulting value is the shift in electrical degree.
<i>Limitation</i>	
<i>Execution</i>	Amplifier disabled.
<i>Remarks</i>	

### Phase lead factor

---

<i>Command</i>	<b>72</b> (0x48)
<i>Parameters</i>	16 bits. (55-7446)
<i>Conversion</i>	$4.57771654e-5$ (electrical degree / 1000 rpm)
<i>Limitation</i>	
<i>Execution</i>	
<i>Remarks</i>	<a href="#">See also Part 1, chapter 6, section 3.1.</a>

### Encoder output marker pulse

---

<i>Command</i>	<b>73</b> (0x49)
<i>Parameters</i>	1st word: number of encoder pulses (1-16). 2nd word: phase shift with regard to the resolver zero (0-65535). 3rd word: marker pulse width (16-32767).
<i>Conversion</i>	Marker pulse phase shift: 65536 is equivalent to 360°. Marker pulse width: 65536 is equivalent to 360°.
<i>Limitation</i>	Number of marker pulses: 1 to 16. Phase shift with regard to the resolver zero: 0 to 65535. Marker pulse width: 16-32767.
<i>Execution</i>	
<i>Remarks</i>	The amplifier takes into account the phase shift value with regard to the resolver zero and the number of marker pulses during the index research procedure ( <a href="#">command 97</a> ). The encoder output takes into account these values only after execution of the procedure "encoder output programming".

### Encoder output resolution

---

<i>Command</i>	<b>74</b> (0x4A)								
	defines the encoder output resolution.								
<i>Parameters</i>	1 word: encoder resolution								
<i>Conversion</i>									
<i>Limitation</i>	The encoder resolution is limited by the maximum application speed.								
	<table> <thead> <tr> <th>Max. speed</th> <th>Max. encoder resolution</th> </tr> </thead> <tbody> <tr> <td>100-900</td> <td>8192</td> </tr> <tr> <td>900-3600</td> <td>4096</td> </tr> <tr> <td>3600-14000</td> <td>1024</td> </tr> </tbody> </table>	Max. speed	Max. encoder resolution	100-900	8192	900-3600	4096	3600-14000	1024
Max. speed	Max. encoder resolution								
100-900	8192								
900-3600	4096								
3600-14000	1024								
<i>Execution</i>	Amplifier disabled.								
<i>Remarks</i>	The encoder output is only effective after the execution of the encoder output programming procedure ( <a href="#">command 98</a> ).								

### Cogging torque compensation

---

<i>Command</i>	<b>75</b> (0x4B)
<i>Parameters</i>	1 word
	0        disables the compensation
	≠0      enables the compensation
<i>Conversion</i>	
<i>Limitation</i>	The "CT-EMF" option must be available and the cogging torque identification procedure must be executed before ( <a href="#">command 100</a> ).
<i>Execution</i>	
<i>Remarks</i>	For more information, <a href="#">see manual "Options BPCW", part 1.</a>

## 2.3 - CURRENT LIMITATION PARAMETERS

### Maximum current

---

<i>Command</i>	<b>76</b> (0x4C)
	defines the maximum current limitation in the motor.
<i>Parameters</i>	1 word
<i>Conversion</i>	in percent of the amplifier current sizing: x 3.051850948e-3
<i>Limitation</i>	6554 (20%) to 32767 (100 %)
<i>Execution</i>	
<i>Remarks</i>	This parameter is set according to the amplifier and motor specifications.

### Rated current

---

<i>Command</i>	<b>77</b> (0x4D)
	defines the rated current limitation in the motor.
<i>Parameters</i>	1 word
<i>Conversion</i>	in percent of the amplifier current sizing : x 3.051850948e-3.
<i>Limitation</i>	6554 (20 %) to 16384 (50 %)
<i>Execution</i>	
<i>Remarks</i>	This parameter is set according to the amplifier and motor specifications.

### I<sup>2</sup>t mode

---

<i>Command</i>	<b>78</b> (0x4E)
<i>Parameters</i>	1 word
	0        limiting mode.
	1        fusing mode.
<i>Conversion</i>	
<i>Limitation</i>	
<i>Execution</i>	
<i>Remarks</i>	For the I <sup>2</sup> t operation mode, <a href="#">see standard manual of the SMT-BD1 amplifier.</a>

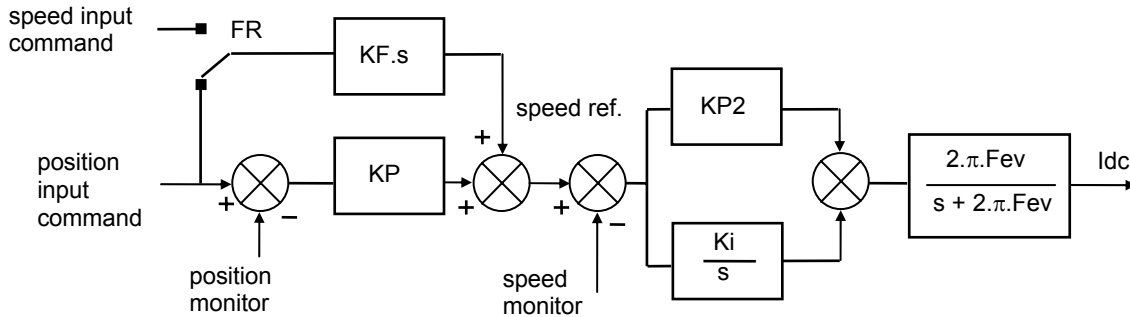
### Current limitation

---

<i>Command</i>	<b>79</b> (0x4F)
	defines the current limitation in the motor with regard to the value defined by the <a href="#">command 76</a> (maximum current).
<i>Conversion</i>	
<i>Parameters</i>	1 word
<i>Limitation</i>	0 to 32767 (100 % I <sub>max</sub> )
<i>Execution</i>	
<i>Remarks</i>	

## 2.4 - REGULATOR PARAMETERS (POSITION AND SPEED)

The structure of the regulator is shown below:



All these gain parameters (KF, KP1, KP2, Ki and Fev) are automatically calculated during the auto-tuning procedure.

### Proportional gain of the speed loop

---

<b>Command</b>	<b>81 (0x51)</b> defines the proportional gain (KP2) of the regulator, that is acting on the speed error.
<b>Parameters</b>	1 word
<b>Conversion</b>	1/16
<b>Limitation</b>	0 to 65535
<b>Execution</b>	
<b>Remarks</b>	

### Integral gain of the speed loop

---

<b>Command</b>	<b>82 (0x52)</b> defines the integral gain (KI) of the regulator, that is acting on the speed error.
<b>Parameters</b>	1 word
<b>Conversion</b>	1/256
<b>Limitation</b>	0 to 65535
<b>Execution</b>	
<b>Remarks</b>	

### Proportional gain of the position loop

---

<b>Command</b>	<b>83 (0x53)</b> defines the proportional gain that is acting on the position error (KP1).
<b>Parameters</b>	1 word
<b>Conversion</b>	1/65536
<b>Limitation</b>	0 to 65535
<b>Execution</b>	
<b>Remarks</b>	

### Feedforward

---

<b>Command</b>	<b>84 (0x54)</b> defines the feedforward amplitude (KF) corresponding to the a priori speed input command (derivation of the position input command). This feedforward term allows to reduce the following error during the motor acceleration and deceleration phases.
<b>Parameters</b>	1 word
<b>Conversion</b>	1/65536
<b>Limitation</b>	0 to 65535
<b>Execution</b>	
<b>Remarks</b>	

### Acceleration ramp

---

<i>Command</i>	<b>85</b> (0x55) defines the acceleration or deceleration time of the motor, that is corresponding to the maximum speed.
<i>Parameters</i>	1 word.
<i>Conversion</i>	in second: x 0.0005
<i>Limitation</i>	1 (without acceleration ramp) to 65535 (# 30 s).
<i>Execution</i>	
<i>Remarks</i>	This parameter is only useful in speed mode.

### Current control low pass filter

---

<i>Command</i>	<b>86</b> (0x56) defines the cut-off frequency at -3dB (Fev) of the first order filter that is acting on the current control. The value of this parameter is depending on the selected bandwidth.
<i>Parameters</i>	1 word.
<i>Conversion</i>	Frequency (Hz) = $1000/\pi * \text{Ln}(65536/\text{parameter})$
<i>Limitation</i>	This parameter can have a value between 2832 (1000 Hz) and 61545 (20 Hz).
<i>Execution</i>	
<i>Remarks</i>	

### Enable/disable the antiresonance filter

---

<i>Command</i>	<b>87</b> (0x57)
<i>Parameters</i>	1 word. 0        disables the antiresonance filter. ≠ 0     enables the antiresonance filter.
<i>Conversion</i>	
<i>Limitation</i>	
<i>Execution</i>	
<i>Remarks</i>	This command must be used when the gain parameters are manually sent or programmed. In this case, and according to the gains adjusted with or without antiresonance filter, the filter must be enabled or disabled by means of this command.

### Stability gain adjustment

---

<i>Command</i>	<b>89</b> (0x59)
<i>Parameters</i>	1 word. -1       reduces the gains. 1        increases the gains.
<i>Conversion</i>	
<i>Limitation</i>	
<i>Execution</i>	
<i>Remarks</i>	This command allows to increase or reduce the gains while maintaining the speed and position loop stability which gain parameters are calculated by the auto-tuning procedure.

## 2.5 - PARAMETERS « UTILITY FUNCTIONS »

### Enabling

---

<i>Command</i>	<b>91</b> (0x5B) Enables the amplifier with a time delay of the brake relay output.
<i>Parameters</i>	1 word. This parameter gives, in ms, the time between the enabling and the disabling of the brake relay output. - enabling of the amplifier - time delay - disabling of the brake relay output.
<i>Conversion</i>	
<i>Limitation</i>	Writing only. The maximum time is 16 s.
<i>Execution</i>	
<i>Remarks</i>	The amplifier can only be enabled by this command. The ENABLE signal is a necessary but not sufficient condition. In standard, the amplifier is disabled at power on. If the parameter is ≠ 0, the end of the time delay is indicated by bit 14 of the procedures status ( <a href="#">command 53</a> ).

### Disabling

---

<i>Command</i>	<b>92</b> (0x5C)
	Disables the amplifier with a time delay of the brake relay output.
<i>Parameters</i>	1 word. This parameter gives, in ms, the time between the enabling of the brake relay output and the disabling of the amplifier. <ul style="list-style-type: none"> <li>- enabling of the brake relay output.</li> <li>- time delay.</li> <li>- disabling of the amplifier.</li> </ul>
<i>Conversion</i>	
<i>Limitation</i>	Writing only. The maximum time is 16 s.
<i>Execution</i>	
<i>Remarks</i>	When the parameter is $\neq 0$ , the end of the time delay is displayed by bit 14 of the procedures status ( <a href="#">command 53</a> ).

### Amplifier fault RESET

---

<i>Command</i>	<b>93</b> (0x5D)
<i>Parameters</i>	None.
<i>Conversion</i>	
<i>Limitation</i>	Writing only.
<i>Execution</i>	
<i>Remarks</i>	The fault RESET command also cancels any procedure during its execution.

### Saving in the EEPROM

---

<i>Command</i>	<b>94</b> (0x5E)
	Saves all amplifier parameters in the EEPROM.
<i>Parameters</i>	None.
<i>Conversion</i>	
<i>Limitation</i>	Writing only.
<i>Execution</i>	Amplifier disabled.
<i>Remarks</i>	All parameters modified by the other commands mentioned in this manual are not stored. This command must be executed in order to definitely store them in the amplifier.

### Auto-phasing

---

<i>Command</i>	<b>95</b> (0x5F)
<i>Parameters</i>	None.
<i>Conversion</i>	
<i>Limitation</i>	Writing only.
<i>Execution</i>	
<i>Remarks</i>	<p>This procedure allows the automatic calculation of the motor parameters:</p> <ul style="list-style-type: none"> <li>- number of motor pole pairs,</li> <li>- motor phases order,</li> <li>- resolver offset.</li> </ul> <p>The motor must first be disabled by means of <a href="#">command 92</a> and uncoupled from its mechanical load. The ENABLE signal must be activated (after execution of command 92). Before starting the procedure, check that the motor shaft is free and that its rotation over one revolution is not dangerous for the operator.</p>



### Auto-tuning

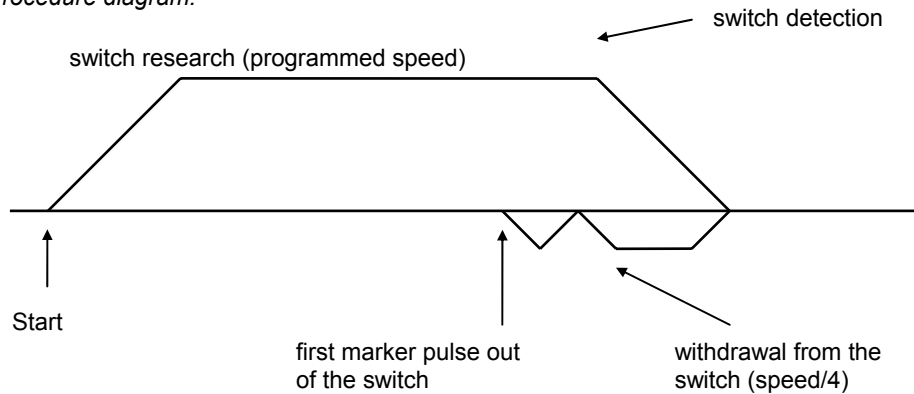
<b>Command</b>	<b>96 (0x60)</b> This procedure identifies the motor and load specifications and calculates the regulator gain parameters.
<b>Parameters</b>	1 word. 0 = low bandwidth 1 = medium bandwidth 2 = high bandwidth 3 = low bandwidth with antiresonance filter 4 = medium bandwidth with antiresonance filter 5 = high bandwidth with antiresonance filter
<b>Conversion</b>	
<b>Limitation</b>	
<b>Execution</b>	With disabled amplifier: via <a href="#">command 92</a> and ENABLE signal activated. With enabled amplifier: at zero speed.
<b>Remarks</b>	During the procedure execution, the operator can select the speed loop bandwidth (Low, Medium, High). These values correspond to the cut-off frequency for a 45° speed loop phase shift. The reading gives the bandwidth used before (0, 1, 2, 3, 4 or 5). Before starting the procedure, check that the motor shaft is free and that a rotation over one revolution is not dangerous for the operator.

### Index research procedure

<b>Command</b>	<b>97 (0x61)</b>																								
<b>Parameters</b>	- 1 byte: command																								
	<table border="1"> <thead> <tr> <th>Bit (0-7)</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0 Leaves index research procedure 1 Starts the procedure</td> </tr> <tr> <td>1</td> <td>Index research with switch</td> </tr> <tr> <td>2</td> <td>Index research on marker pulse</td> </tr> <tr> <td></td> <td>Combination of bits 1 and 2:</td> </tr> <tr> <td></td> <td>01 with switch</td> </tr> <tr> <td></td> <td>10 on marker pulse</td> </tr> <tr> <td></td> <td>11 with switch and on marker pulse</td> </tr> <tr> <td></td> <td>00 position reset</td> </tr> <tr> <td>3</td> <td>0 positive direction 1 negative direction</td> </tr> <tr> <td>4</td> <td>0 parameter = displacement speed + TimeOut 1 parameter = index position</td> </tr> <tr> <td>5</td> <td>1 cancels the index research procedure. The motor will be stopped: leave the index research mode by means of bit 0.</td> </tr> </tbody> </table>	Bit (0-7)	Meaning	0	0 Leaves index research procedure 1 Starts the procedure	1	Index research with switch	2	Index research on marker pulse		Combination of bits 1 and 2:		01 with switch		10 on marker pulse		11 with switch and on marker pulse		00 position reset	3	0 positive direction 1 negative direction	4	0 parameter = displacement speed + TimeOut 1 parameter = index position	5	1 cancels the index research procedure. The motor will be stopped: leave the index research mode by means of bit 0.
Bit (0-7)	Meaning																								
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	- 1 word: displacement speed defined in percentage of the maximum speed defined by command 61. A value of 32767 corresponds to the maximum speed.																								
	1 word: TimeOut. Limited procedure time in seconds (max. 32767 s)																								
	- or 1 word 32 bits: Position "preset" . This value will be allocated to the index position found. Same format as the 32 bit position ( <a href="#">see command 42</a> ). In standard, this value is 0.																								
<b>Conversion</b>																									
<b>Limitation</b>																									
<b>Execution</b>	With enabled amplifier and in position mode ( <a href="#">command 40</a> ).																								
<b>Remarks</b>	When bit 0 of the first byte is set at 1, bit 3 must be = 0; this means that it is not possible to start the procedure and send a "preset" position at the same time. The parameter must be the speed and TimeOut. During the procedure execution, the NC must always send the synchronous message and the input command message. When the index position has been found, the motor is standing still. Bit 5 of the procedures status ( <a href="#">command 53</a> ) remains at 1 and bit 14 is set at 1. The NC must readjust the position input command message according to the new position sent by the amplifier and leave the index research procedure (bit 1 of the first byte of <a href="#">command 97</a> = 0). Bit 5 of the procedures status is switching on to 0. The amplifier will then follow again the position input command of the NC.  The resolver marker pulse position can be modified by the value of the encoder output marker pulse shift ( <a href="#">command 73</a> ).  Acceleration and deceleration are firm and equal to 384 rad/s <sup>2</sup> .  On the SMT-BD1/h amplifiers, it is not advisable to make the indexing with the single switch (without marker pulse). The detection accuracy of the switch is limited by the speed:																								

$\varepsilon P \leq 2.08333.10^{-6}$  Speed (speed in rpm)

Procedure diagram:



It is possible to "force" the position counter with a value given by the value "0x01" in the command byte, that is neither switch nor marker pulse. In this special case, the amplifier does not need to be enabled.

### Encoder output programming

**Command** **98** (0x62)  
This procedure programs the encoder output by means of the parameters defined by the commands [73](#) and [74](#).

*Parameters*

*Conversion*

*Limitation* Writing only

*Execution* Amplifier disabled

*Remarks*

### Manual brake relay control

**Command** **99** (0x63)  
This command allows to enable or disable the brake.

**Parameters** 1 word  
0 disables the brake relay output (relay closed).  
≠0 enables the brake relay output (relay open).

*Conversion*

*Limitation* Writing only

*Execution*

*Remarks*

### Cogging torque identification procedure

**Command** **100** (0x64)  
This command triggers the motor cogging torque identification procedure.

*Parameters*

*Conversion*

*Limitation* Writing only.

*Execution*

*Remarks*

The CT-EMF option must be available.

The motor must previously be disabled by [command 92](#) and uncoupled from its mechanical load. Then, start an auto-tuning procedure with a high bandwidth. The ENABLE signal must also be activated.

Before executing the command, check that the motor shaft is free and that its rotation over 2 revolutions in both directions is not dangerous for the operator.

For more information, see manual "BPCW options", part 1 "Cogging torque compensation".

### Standard parameters reset

---

<i>Command</i>	<b>101</b> (0x65)
<i>Parameters</i>	no parameter.
<i>Conversion</i>	
<i>Limitation</i>	writing only
<i>Execution</i>	
<i>Remarks</i>	This command resets ALL parameters at their standard value. It must be used carefully.

Standard parameters:

<b>Parameters</b>	<b>Value</b>	<b>Meaning</b>
40 (0x28)	0x08	Amplifier mode
41 (0x29)	0x07D0	Cycle time
42 (0x2A)	0x1007	Messages configuration
43 (0x2B)	0x0FA0	CAN bus error threshold
50 (0x32)	0x0000	Position resolution
55 (0x37)	0xFFFF	Amplifier faults masking
60 (0x3C)	0x00, 0x00	Rotation reversal
61 (0x3D)	0x0666	Max. application speed
65 (0x41)	0x07FF	Position error threshold
68 (0x44)	0x0001, 0x0000	CI input filtering
69 (0x45)	0x0000	Bandwidth
71 (0x47)	0x5555, 0x1000, 0x04	Motor parameters
72 (0x48)	0x0000	Phase lead factor
73 (0x49)	0x0001, 0x0000, 0x0020	Encoder output marker pulse
74 (0x4A)	0x0400	Encoder output resolution
75 (0x4B)	0x0000	Cogging torque compensation
76 (0x4C)	0x7FFF	Maximum current
77 (0x4D)	0x3FFF	Rated current
78 (0x4E)	0x0008	I <sup>2</sup> t mode
79 (0x4F)	0x7FFF	Current limitation (not stored)
81 (0x51)	0x00C0	Proportional speed loop gain
82 (0x82)	0x0080	Integral speed loop gain
83 (0x83)	0x03D7	Proportional position loop gain
84 (0x84)	0xFFFF	Feedforward term
85 (0x85)	0x0001	Acceleration ramp
86 (0x86)	0x9C54	Current input command lowpass filter

## Chapter 4 - Messages identifiers

### 1 - SYNCHRONOUS MESSAGES

#### - Synchro messages:

m\_ScG0 : Identifier = 16 (010h)  
 m\_ScG1 : Identifier = 48 (030h)  
 m\_SrG0 : Identifier = 32 (020h)  
 m\_SrG1 : Identifier = 64 (040h)

Length of the message : 0 byte.

#### - Command messages: m\_Cmd

Identifier:

10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	1	1	0	Ad3	Ad2	Ad1	Ad0

[Ad3 Ad2 Ad1 Ad0] is the amplifier address (1 to 15).

Length of the message: programmable.

#### - Information feedback messages: m\_Ret

Identifier:

10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	1	1	1	Ad3	Ad2	Ad1	Ad0

[Ad3 Ad2 Ad1 Ad0] est l'adresse du variateur (1 à 15).

Length of the message: programmable.

### 2 - ASYNCHRONOUS MESSAGES

#### - Message m\_Req :

Identifier = 160 (0A0h)

#### - Message m\_Res :

Identifier = 176 (0B0h)